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GAPS AND OPPORTUNITIES FOR AGRICULTURAL SECTOR DEVELOPMENT IN MOZAMBIQUE

by

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Forward

Directorate of Economics

The Directorate of Economics of the Ministry of Agriculture and Rural Development maintains two publication series for research on food security issues. Publications under the Flash series are short (3 - 4 pages), carefully focused reports designated to provide timely research results on issues of great interest. Publications under the Research Paper series are designed to provide longer, more in depth treatment of food security issues. The preparation of Flash reports and Research Reports, and their discussion with those who design and influence programs and policies in Mozambique, is an important step in the Directorate's overall analyses and planning mission.

Comments and suggestion from interested users on reports under each of these series help identify additional questions for consideration in later data analyses and report writing, and in the design od further research activities. Users of these reports are encouraged to submit comments and inform us of on-going information and analysis needs.

Carlos Mucavele
National Director
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Authors Forward and Acknowledgements

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The field research in Mozambique was conducted in June and July of 2002, with document preparation through October 15, 2002, and revisions completed in March 2003. Identifying the key leverage points and gaps to fill in research, extension, and institutional development (in the broad sense of the word) to enable both growth and poverty reduction is a very large challenge. The authors sought every opportunity to talk to people in the public, private (farmers, traders, processors), and non-governmental sector. They reflected on their own experiences as well. In a large country with so many agents active and so much diversity, the authors regret that the contributions of all may not be reflected in this document.

We would like to thank the people who shared their time, information, documents, and, most importantly, their ideas with us. We recognize that this time commitment reflects their respect for the work of the Rockefeller Foundation as well as their interest in seeing agricultural and economic development served in Mozambique.

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Acronym	English	Portuguese
ADIPSA	Support for the development of private initiatives in agricultural sector	Apoio ao desenvolvimento de iniciativas privadas no sector agrário
ADRA	Adventist Development and Relief Agency	
AGOA	African Growth Opportunity Act	
AICHA	Agricultural Initiative to Cut Hunger in Africa (USAID)	
ANE	Roads Authority	Autoridade Rodoviária
BPD		Banco Popular de Desenvolvimento
CAP	Agricultural and Livestock census, 1999/2000	Censo agro-pecuário 1999/2000
CIMMYT	International Maize and Wheat Research Center	
CLUSA	Cooperative League of U.S.A	
CNFA	Citizens Network for Foreign Affairs	
CTIA	Temporary research governing council	
DHS	Demographic and Health Survey	
DINAGECA	National Directorate of Geography and Cadastre	Dirrecção National de Geografia e Cadastro
DNDR	National Directorate for Rural Development (MADER)	Dirrecção National de Desenvolvimento Rural (MADER)
DNER	National Directorate for Rural Extension (MADER)	Dirrecção National de Extensão Rural (MADER)
DPA	Provincial Directorate of Agriculture	Direcção Provincial da Agricultura
FAO	Food and Agriculture Organization (UN)	Organização das Nações Unidas para Alimentação e Agricultura
FAEF	Agronomy Faculty at UEM	Facultad de Agronomia (UEM)
FARE	Support Fund for Economic Rehabilitation	Fundo de Apoio a Reabilitação da Economia
FHI	Food for the Hungry International	
GAPI	Unit for Consultancy and Assistance of Small Industries	Gabinete de Consultoria e Apoio a Pequena Indústria
GPSCA	Office for the Promotion of Commercial Agriculture	Gabinete de Promoção do Sector Comercial Agrario
IARC	International Agricultural Research Center	
ICM	Mozambican Cereals Insitute (para-statal)	Instituto de Cereais de Moçambique
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics	
IFC	International Finance Corporation	
INE	National Institute of Statistics	
INIA	National Agricultural Research Institute	Instituto National de Investigação Agronómica
INNOQ	National Institute for Normalization and Quality	Instituto National de Normalização e Qualidade
MADER, (formerly MAP)	Ministry of Agriculture and Rural Development (formerly Ministry of Agriculture and Fisheries)	Ministério da Agricultura e Desenvolvimento Rural (Ministério da Agricultura e Pecuaria)
MADER/DE	Ministry of Agriculture and Rural Development/ Directorate of Economics	Ministério da Agricultura e Desenvolvimento Rural/ Direcção da Economia

Acronym	English	Portuguese
MIC	Ministry of Industry and Trade	Ministério da Industria e Comércio
MICOA	Ministry for the Coordination of Environmental Action	Ministério para a Coordenação da Acção Ambiental
MISAU	Ministry of Health	
MSU	Michigan State University	
ORAM	Rural Organization for Mutual Assistance	Organização Rural de Ajuda Mútua
OVATA		
PARPA	Action Plan for the Reduction of Absolute Poverty	Plano de Acção de Reducção da Pobreza
PASANA		Programa de Agricultura Sostentável de Nampula
PESU	Emergency Program for Seeds and Implements	Programa de Emergência para Sementes e Utensílios
PNS	National Seed Program	Programa National de Sementes
PODE	Enterprise Development Program	Programa de Desenvolvimento
PROAGRI	Agricultural Sector Public Expenditure Programme	Programa Nacional para o Desenvolvimento Agricola
RM		Rádio Moçambique
SADC	Southern African Development Community	
SADLAF	Southern Africa Drought and Soil Fertility project	
SARRNET	Southern Africa Root Crops Research Network	
SETSAN	Technical Secretariat for Food Security and Nutrition	
SG2000	Sasakawa Global 2000	
SIMA	Agricultural Market Information System	Sistema de Informação dos Mercados Agrícolas
SNS	National Seeds Service	Serviço Nacional de Sementes
SWAPs	Sector Wide Approaches (World Bank)	
TIA96	Agricultural Household Survey, 1996	Trabalho de Inquérito Agrícola, 1996
T&V	Training and Visit (extension)	
UEM	University of Eduardo Mondlane	Universidade de Eduardo Mondlane
UNAC	National Union for Farmers	União National de Camponeses
UCASNI	Farmers Union of Southern Niassa	União de Camponeses de Sul de Niassa
UNDAF	United Nations Development Assistance Framework	
USAID	United States Agency for International Development	
WV	World Vision	
ZADP	Zambezia Agricultural Development Project (World Vision)	
ZMM-GT	Zambia/Malawi/Mozambique Growth Triangle	

1. Identifying and Characterizing the Food Insecure

a. Overview of national food balance and nutritional trends

Each year, the Ministry of Commerce and Tourism (MIC) with FAO assistance prepares the basic food balance sheet, highlighting availability and needs of cereals and other basic foods (Table 1.1) (MIC/DNC, 2002). This assessment is based solely on supplies and does not evaluate actual access or consumption by households. For the 2002/2003 marketing year, there are expected to be commercial exports of maize and other food crops, primarily to Malawi and Zambia, due to the drought and high prices being paid for delivery there.[1] Mozambique did have some areas of drought or erratic rainfall, however, affecting total production, such that production was down in some regions for 2001/2002 crop year, which supplies the 2002/2003 commercial year (Table 1.2). The regional balance sheets demonstrate the differences in basic food availability between north and south, in which the north is the agriculturally most productive region of the country and the south is typically deficit in basic foods, with the center region also slightly deficit, depending upon the year.

Mozambican policy makers face major challenges due to the domestic regional differences in demand and production. The south (consisting of Maputo, Gaza and Inhambane Provinces) is primarily a region of limited agricultural production, with deficits for grain reaching over 600, 000 metric tons for this year (Table 1.2). The capital city Maputo is the main consumption market for the country and is located in the far south of the country. Meanwhile, the center and north have surpluses of most of the basic food commodities, except wheat (Table 1.2). Generally, the south obtains food supplies from South African imports, as well as from the center production zones, whereas the northern zones produce sufficient supplies for export to Malawi, Zambia and elsewhere. While the government would like to see the north supplying the food needs of the south, the transport and other infrastructure do not make that economically sound in the near future. On the whole, though, Mozambique is not facing the acute shortages of other countries in the region and generally has the capacity to produce sufficient food to meet basic needs.

Figure 1.1 shows the trends in kilocalorie consumption, indicating a slight improvement in recent years, although still on average below the 2100 kcal/adult equivalent/daily minimum. Consumption was lowered during the years after Independence with the civil war, but is now recovering, with increased fats and oils intakes, as production systems recover and market availability of goods in rural areas improves.

Figure 1.2 shows the trends in consumption of main food groups over time, aggregated across rural and urban consumption. Maize is the main cereal consumption crop, grown by 79% of rural households (MADER, 2001b) and a basis of the diet for most Mozambicans. Cassava is the second most important food crop and the principal tuber crop, primarily for home consumption. Groundnuts and beans are also grown by at least 40% of the rural households, and the consumption component is gradually rising for this group. Sweeteners became expensive and unavailable for rural populations, contributing to the decline in consumption. Donated vegetable oils during the crisis years increased consumption of oils, and now with more local presses in rural areas, it is hoped that rural consumption of oils will increase.

[1] There are currently discussions about donors purchasing 40000 metric tons of white maize in Mozambique in 2002 for food aid export to Malawi. That is not considered in these balance sheets.

Table 1.1: Mozambique annual projected food balance sheet for marketing year 2002/2003 (April to March)

		Maize	Rice [1]	Wheat	Sorghum/ Millet	Total Cereals	Cassava (fresh) [2]	Other Tubers [3]	Beans/ Groundnuts [4]
						(in 000 mt)			
A. Total availability		1253	134	40	384	1811	5380	547	298
A.1	Initial Stocks	17	27	40	25	109	345	17	11
	Monitored [5]	9	21	40	0	70	80	0	0
	Non-monitored [6]	8	6	0	25	39	265	17	11
A.2	Gross Production (2001/2002) [7]	1236	107	0	359	1702	5036	530	287
B. Consumption needs		1275	321	282	378	2257	5029	471	301
Human consumption [8]		1091	307	282	327	2007	3617	286	259
Industrial consumption/feeds [9]		32	0	0	14	47	101	0	0
Seeds [10]		28	9	0	8	46	0	0	19
Losses [11]		124	5	0	29	158	1312	185	23
C. Deficit (-) / Surplus (+)		-22	-187	-242	6	-446	351	75	-3
D. Imports		167	220	288	0	675	0	0	20
D.1	Imports: arrived	7	0	0	0	7	0	0	0
	Commercial imports: formal	5	0	0	0	5	0	0	0
	Commercial imports: informal	2	0	0	0	2	0	0	0
	Food aid for market sales	0	0	0	0	0	0	0	0
	Food aid for emergency distribution	0	0	0	0	0	0	0	0
D.2	Imports: predicted [12]	160	220	288	0	668	0	0	20
	Commercial imports: formal	100	205	250	0	555	0	0	10
	Commercial imports: informal [13]	20	0	0	0	20	0	0	10
	Food aid for market sales	0	15	38	0	53	0	0	0
	Food aid for emergency distribution [14]	40	0	0	0	40	0	0	0
E. Exports [12]		130	0	0	0	130	30	0	12
Commercial imports: formal		60	0	0	0	60	10	0	6
Commercial imports: informal		70	0	0	0	70	20	0	6
F. Final stock estimates (+/-)		15	33	46	6	99	321	75	5
Unmet needs (C+D-E)									

Source: Ministry of Commerce and Tourism, Boletim no. 43 and 44, March and April 2002. Distributed electronically. May 2002, Maputo.

Notes:
[1] Dehulled rice. Gross paddy production multiplied by 0.65 to get dehulled rice total.
[2] Available fresh mandioca available is calculated as 85% of gross production estimate from the National Early Warning System (SNAP)
[3] Calculated to be 7.5% of cassava production.
[4] Unshelled grounduts
[5] Stocks of larger scale industry and formal traders
[6] Stocks of farmers and smallscale industry and commercial traders
[7] Final production estimates provided by SNAP
[8] Human consumption of cereals represent 80% (1680 Kcal/person/day) of the total diet (2100 Kcal/person/day), converted into total production needs based on a population of 18.2 million people, as of 1 October 2002.
[9] Needs for production of beers, various foods, livestock feed, and others.
[10] Seed requirements (2.3% of maize production; 2.3% of millet production; 9,000 tons estimated for rice)
[11] Losses in maize estimated at 10%; rice 5% losses; millet/sorghum, beans and groundnuts 8% losses; cassava and other tubers 30%. The effects of brown streak vitus on cassava is significant in the coastal lowlans of Cabo Delgado, Nampula, and Zambezia provi
[12] Preliminary estimates
[13] Principally in the flour form for maize and wheat
[14] Emergency food aid maize may be yellow or white maize.

Table 1.2 Regional food balance sheets (000's metric tons) 2002/2003

		Commercial year 2002/2003 (April/March)							
Northern region (Cabo Delgado, Niassa, Nampula & Zambézia [1])		**Maize**	**Rice [2]**	**Wheat**	**Sorghum/ Millet**	**Total Cereals**	**Cassava (fresh) [3]**	**Other Tubers [4]**	**Beans/ Groundnuts [5]**
A.	Total availability	**662**	**91**	**10**	**238**	**1,000**	**4,700**	**461**	**201**
A.1	Initial Stocks	6	7	10	10	33	190	10	5
	Monitored [6]	2	5	10	0	17	40	0	0
	Non-monitored [7]	4	2	0	10	16	150	10	5
A.2	Gross Production (2001/2002) [8]	656	84	0	228	967	4,510	451	196
B.	Consumption needs	**353**	**81**	**56**	**238**	**728**	**4,114**	**416**	**193**
	Human consumption [9]	259	72	56	205	592	2,896	258	167
	Industrial consumption/feeds [10]	13	0	0	9	22	90	0	0
	Seeds [11]	15	5	0	5	25	0	0	11
	Losses [12]	66	4	0	18	88	1,128	158	16
C.	Deficit (-) / Surplus (+)	**309**	**10**	**-46**	**0**	**273**	**587**	**45**	**8**
Southern region (Inhambane, Gaza & Maputo)									
A.	Total availability	**130**	**20**	**18**	**18**	**189**	**470**	**67**	**59**
A.1	Initial Stocks	6	12	18	2	41	25	0	2
	Monitored [6]	5	10	18	0	33	10	0	0
	Non-monitored [7]	1	2	0	5	8	15	0	2
A.2	Gross Production (2001/2002) [8]	124	8	0	16	148	446	67	57
B.	Consumption needs	**422**	**161**	**191**	**26**	**801**	**530**	**47**	**71**
	Human consumption [9]	397	159	191	24	771	365	24	61
	Industrial consumption/feeds [10]	10	0	0	1	11	9	0	0
	Seeds [11]	3	2	0	0	5	0	0	6
	Losses [12]	12	0	0	1	14	156	23	5
C.	Deficit (-) / Surplus (+)	**-292**	**-141**	**-173**	**-8**	**-612**	**-60**	**19**	**-13**

Notes: [1]For convenience of this balance sheet in terms of agricultural commerce, Zambezia Province is considered part of the Northern region, rather that Central.
[2]De-hulled rice. Gross paddy production multiplied by 0.65 to get de-hulled rice total.
[3]Available fresh cassava available is calculated as 85% of gross production. Industrial/rations used is estimated at 10% of production.
[4]Calculated at 7% (North, 15% (Center), and 15% (South) of the gross production of cassava.
[5]Unshelled groundnuts.
[6]Stocks of larger scale industry and formal traders.
[7]Stocks of farmers.
[8]Final production estimates provided by SNAP.

For the micronutrients, iron deficiency, lack of vitamin A, and vitamin C are problems with severe health consequences, sometimes just localized, as will be shown below. Efforts at food-based nutrient improvements are increasing in Mozambique, primarily using quality protein maize and orange-fleshed sweet potatoes, diversification crops, as well as nutrition education.

b. Projections to 2015 or 2020

These researchers found no projections for food production and balance sheets, but experts indicate that in most years, Mozambique has the capacity to meet basic consumption needs, although costs and prices make it common for the northern and central regions to export while the southern region imports. Population projections have predicted slower population growth due to HIV/AIDS, with total population growing to 19.7 by the year 2010 from an estimated 17.2 million in 2000 (United Nations, 2001). With agricultural output growth of 8-9% annual compared to population growth rates of less than 2%, and given that about 80% of the population is based in rural areas and dependent on agriculture, the general outlook is positive. As World Bank staff note, with only 15% of arable land currently under cultivation, there is room for continued growth through area expansion in agricultural production (World Bank 1999).

c. Spatial distribution of current poverty and malnutrition

1. Energy, macronutrient, micronutrient, anthropometric indexes

The Ministry of Health with the Ministry of Planning and Finance have developed a set of district profiles for the entire country, based on research in the rural zones of each district, excluding the urban zones of Maputo, Beira and other cities (MINSAU and MINIPLAN, 1997, 1998 a-f, 1999a-b, 2000, 2001).[2] District profiles identified the "food economy zones" (Figure 1.3) using focus groups and other rapid appraisal techniques and secondary data to understand the dynamics of food security and nutrition in each district: agricultural production, climate and soils, sources of income, foods, health and nutrition, markets, access to services for health and education, and other aspects.[3] The profiles were conducted over the period 1996-1999, so not every profile covers the same year.

The food economy zones group together areas that are similar in agricultural commodities produced and production potential, as well as main consumption goods and sources of income. There are highly productive zones (North and Central interior, Productive zone of Tete and the North zone with cotton and groundnuts). The coastal zones have fisheries and other sources of income and consumption, in addition agriculture. The semi-arid zones are where livestock

[2] The following urban zones in districts are excluded: Maputo City, Nampula City, Beira, Nacala-Porto, Angoche, Ilha de Moçambique, and Quelimane. Other urban zones (for example, Xai Xia, Homoine, Chimoio, Lichinga, and Tete City) have probably also been excluded in these rural diagnostics, but the exclusion was not noted specifically in provincial reports. We assume that they have been.

[3] This section of the document relies heavily on work from two sources. The district profiles and resulting documents along with the summary document (MINSAU, MADER/SETSAN, and FAO 2001) with FAO support, provide important disaggregated information, based on extensive field work over an extended period, work which merits wider diffusion, but is unavailable in English. The analysis from the household survey conducted in 1996/97 and analyzed by a team at the Ministry of Finance and Planning with technical support from IFPRI (MINIPLAN, UEM, and IFPRI, 1998) provides the quantitative approach. The sample did not permit a more disaggregated analysis down to the district level, but provides key insights into the nature of poverty and food insecurity in Mozambique.

begins to play a role in income, agricultural sources of income are reduced, and vulnerability is generally considered high. As expected, these zones roughly correspond to the agro ecological zones map (Figure 1.4).

The district profiles show two basic anthropometric indicators for their surveillance efforts. First, they evaluate birth weights, and determine the percentage of low birth weight children, where low birth weight is considered to be less than 2.5 kilograms. If more than 7% of births are low birth weight, problems are indicated. Figure 1.5 indicates that the northern part of the Center and much of the north suffer from low birth weights.

The second anthropometric measure is low weight gain by infants, based on 1-3 month intervals during post-natal visits for a selected year. As can be seen in Figure 1.6, there are districts with critical problems with child nutrition and disease resulting in low weight gain, particularly in Tete and Niassa province, zones with very difficult access. Among other causes, a maize or cassava based diet without proteins or fats can lead to stunting over time.

In the National Living Conditions Survey in 1996/97, the pattern of problems indicated by anthropometric measures continues for the Center region (MINIPLAN, UEM, and IFPRI, 1998). Fifty-five percent of children under age five have low height for age measures, indicating stunting, in the Center, whereas the North and South are 38% and 36% respectively. For wasting (low weight for height, also considered acuter malnutrition), the North has 8% of its children with wasting, whereas the center and south are 4 to 5 % of their children. Malnutrition and poor health contribute to these conditions in children. Acute malnutrition reflects a combination of inadequate nutrition and inability of the body to use nutrients consumed.

The district profiles used rapid assessment tools to evaluate dietary adequacy, focusing primarily on protein, iron, energy, and vitamin A. In a recent study to validate these qualitative tools, Rose and colleagues (2002) compared the results to a more detailed quantitative consumption survey conducted in specific areas of Cabo Delgado and Nampula Provinces and found that the rapid assessment tools are valuable for assessing dietary adequacy, with the exception of vitamin A. Vitamin A is a difficult nutrient to determine for several reasons. A primary difficulty is that the foods with vitamin A in Mozambique are most often eaten in the hungry season and tend not to provide protein and other nutrients, so they may appear to be related to malnutrition. Current research associated with orange-fleshed sweet potatoes seeks to evaluate dietary vitamin A in Mozambique more thoroughly. There has been little clinical testing to verify this deficiency, but methods devised by Helen Keller Foundation have been used based on consumption, and a special project will be conducting blood tests to verify prevalence and test the efficacy of diet-based nutritional programs to ameliorate the problems (Low et al., 2000). Until then, the existing rapid assessment tools will be used.

Looking at the micronutrients from the district profiles, anemia is a problem in every district for which measures were available (no map shown), and is generally attributed to poor nutrition and disease, including parasites and malaria. Vitamin A deficiencies are prevalent throughout the country (Figure 1.7), a deficiency that can easily be ameliorated by capsules or by changes in diet.

Iodine deficiency is most prevalent in the north and center, with lower prevalence in the southern region (Figure 1.8). Clinical studies in Niassa, Tete and Cabo Delgado found high prevalence, although a full national survey has yet to be conducted. Pellagra, from lack of a

diversified diet, is found currently in Tete and Niassa Provinces (Figure 1.9). Vitamin C deficiencies are primarily in the southern interior parts of the country (Figure 1.10).

Cyanide in bitter cassava results in cases of tropical neuropathy (paralysis) and other problems, if the household does not properly process the cassava. The severe problems are found principally in coastal areas of Nampula (Figure 1.11), but with problems wherever the bitter cassava is produced, including coastal Zambezia and Niassa. There are local technologies that households can use to avoid problems, but the difficulty is in reaching households with extension messages. Previous work with training local activists was having an impact, but due to lack of funding the program was suspended and now problems with cyanide poisoning appear to be on the rise. Work with SARRNET and World Vision is once again trying to increase the education of rural women on this aspect.

No thorough national study has been conducted on the seasonality of consumption and related nutritional adequacy and anthropometric measures. A study by Rose and Tschirley with a sample of households from Cabo Delgado and Nampula Provinces shows that over 54 to 58% of the sample suffered from low intake of proteins, iron, and calories in the "hungry season" (data collected in January), while over 80% of the sample suffered from vitamin A deficiency during this season. This compares to only 8% with protein deficiency and 25% with calorie deficiency in the post-harvest period, as shown in Table 1.3 (Rose and Tschirley, 2000).

Seasonality is addressed briefly in the district profiles, with focus group interviews indicating consumption differences between rich and poor, duration of household food stocks, and consumption shifts during the hungry period each year. Focus groups were asked about the survival strategies of the poorest when their stocks run out and no other income sources are available. A range of options were indicated: 1) reducing number of meals; 2) eating wild foods; 3) seeking emergency food aid; 4) getting funds from relatives elsewhere; 5) working in others fields for food[4] (although this occurs throughout the year). Selling off assets was rejected as a strategy because the poorest households in Mozambique generally have no assets to sell (MINSAU, MADER/SETSAN, and FAO, 2001). As the maps show (Figure 1.12 A-C), there are dispersed patterns, with common strategies of consumption of wild fruits and plants as well as reduced meals.

Table 1.3 Nutrient Consumption: Frequency of low nutrient intakes in Nampula and Cabo Delgado sample by season

	Percent of sample with low intake (<75% of recommended amount)			
Nutrient	All Seasons	Harvest Season	Post-Harvest Season	Hungry Season
Calories	41	40	25	58
Proteins	24	10	8	55
Vitamin A	91	93	98	82
Iron	38	39	20	54

Source: Rose and Tschirley, "A Simplified method of assessing dietary adequacy in Mozambique." Research Report #36, January 2000. MADER/Directorate of Economics.

[4] This working for food is known as "ganho-ganho" in Mozambique and is common throughout southern Africa.

2. Nutrition overlay with population density, agro-ecological zones, market density

Poverty in Mozambique is widespread. As shown in Table 1.4, with high population numbers, Nampula and Zambezia have the highest share of the poor. Sofala stands out as having a higher share of the poor than in the general population. The urban area of Maputo has the lowest proportion of people in poverty. As Figure 1.13 shows, there are many districts in Sofala with a high percentage of people in poverty. There is much more variability between districts in Zambezia and Nampula Provinces. Niassa also shows high variability between districts. Figures 1.14 (a and b) indicate at the administrative post level the variability within districts, both in percentage of population in poverty but also poverty numbers. The clustering of dots in Figure 1.14b shows the high population densities of poor in the coastal areas, as well as throughout Zambezia, Nampula, Manica and other Provinces.

The presence of a market may not truly indicate access to that market for the conditions of roads are an acknowledged constraint throughout the country. In the district profiles, focus groups were asked several different questions concerning access. Most district centers have some kind of a market, although not all, but access to the center gives an indication of market access. There are many district centers that are not easily accessible (Figure 1.15A) and the situation is worse for access to the interior of the districts (Figure 1.15B). The low population areas of the south and Niassa are affected, but even relatively high population density area of Zambezia, Cabo Delgado, and Nampula show areas with very bad access, indicating that private traders and markets are unlikely to be active.

Simler and Nhate (2002) mapped road conditions and then looked to compare that to poverty in the districts and administrative posts. As shown in Figure 1.16, generally where roads are of good quality, poverty tends to be lower, as in parts of Tete Province and in parts of Nampula. There are high-density population areas with poverty that do not have good road access, as in Zambezia Province, reinforcing the previous evaluation by focus groups. The low-density population areas of the south clearly have limited access and high percentage of population in poverty, although low total numbers of people in poverty.

3. Rural and urban distribution

In Mozambique, researchers estimated that 10.9 million people were living in poverty, and 82% of those live in rural areas (about 8.9 million people), and 18% (about 2 million people) in Maputo and other urban areas (MINIPLAN, UEM, and IFPRI, 1998). The urban poverty rate is lower (62% of urban population) compared to the rural poverty rate (71.2% of rural population), estimated for 1996/97; however, the percentage of the population considered food insecure is higher in urban areas (67% of urban population, compared to 64% of rural population).[5] About 50% of the urban population of the country lives in Maputo City, with the rest mainly in provincial capitals.

In rural areas, the northern production areas have much lower rates of food insecurity, with 48% of households considered food insecure, while in the south, up to 78% of households are in that group (MINIPLAN, UEM, and IFPRI, 1998). The better agricultural growing conditions are cited as a major factor influencing food security in the northern zone.

[5] Food insecurity noted here was measured by kilocalorie sufficiency (Garrett and Ruel, 1999).

Table 1.4 Poverty: Incidence of poverty, using various indicators, by Province, 1996/97

Province	Percent of total population	Average consumption	Percent out of total national population in poverty	Poverty Measures (A) Poverty incidence index	(B) Index of differential poverty	(C) Index of squared poverty
	%	(Meticais/ person/month)	%	%	(depth)	(severity)
Niassa	4.9	147,841	4.9	70.6	30.1	16.1
Cabo Delgado	8.2	194,448	6.8	57.4	19.8	9.1
Nampula	19.5	161,668	19.3	68.9	28.6	15.3
Zambezia	20.3	154,832	20.0	68.1	26.0	12.3
Tete	7.3	117,049	8.7	82.3	39.0	22.5
Manica	6.2	191,608	5.6	62.6	24.2	11.7
Sofala	8.8	97,906	11.1	87.9	49.2	32.1
Inhambane	7.1	128,219	8.4	82.6	38.6	21.4
Gaza	6.6	183,233	6.1	64.7	23.0	10.9
Maputo Province	5.1	177,774	4.9	65.6	27.8	14.7
Maputo City	6.1	253,102	4.2	47.8	16.5	7.7

Source: Ministério do Plano e Finanças, Universidade Eduardo Mondlane, Instituto Internacional de Pesquisas em Políticas Alimentares. "Pobreza e bem-estar em Mocambique: Primeira avaliação nacional (1996-97)". Maputo, 1998. Authors' calculations for column 4.

Note: Consumption is the average, adjusted seasonally and spatially, using average national prices as a base.

Poverty measures: (A) is the proportion of households with per capita consumption below the poverty line.
(B) is the average distance below the poverty line as a proportion of the poverty line.
(C) is the average squared difference in poverty and reflects the severity of poverty in that it is sensitive to inequality among the poor.

d. Most food insecure and vulnerable populations

The National Household Living Conditions Survey of 1996/97 has been analyzed to evaluate food insecurity as well as poverty throughout the country (MINIPLAN, UEM, and IFPRI, 1998; Garrett and Ruel, 1999). Analysis shows the basic determinants of food insecurity are similar between urban and rural populations, although there are differences in observed outcomes because the absolute levels of the determinants vary. Overall, the poor and most vulnerable tend to live in larger households with more children. Poorer households tend to have heads with less education than better off households in both urban and rural households. For both urban and rural poor, lack of income generation opportunities is a major factor in poverty. Households in poverty tended to have lower educational levels for women, regardless of whether urban or rural, a factor important in nutritional outcomes. Those households also tend to lack access to a safe water supply (Garrett and Ruel, 1999).

In the rural areas, almost all households have some access to land, but there is a strong correlation of income and land cultivated (Jayne, et al. 2002). Due to a lack of production assets (including improved seeds, agro-chemicals, and animal traction), land and labor productivity in agriculture are low overall, particularly affecting the poorest, as can be evidenced by the lack of marketed output (MINIPLAN, UEM, and IFPRI, 1998). Resorting to informal trading of agricultural labor for food in neighbors' fields, known as "ganho-ganho", is key for the survival strategies of the poorest households.

There are high-density poor populations in Zambezia and Sofala in areas with very difficult access (Figures 1.15 and 1.16). Environmental risk can be associated with some of the poor in the flood threatened regions of Tete and Sofala (Figures 1.15 and 2.2), where people rely primarily on labor sales since food stocks last only three to seven months (MINSAU and MINIPLAN, 1998e and 1998f).

1. **Main livelihood systems (for farming populations, main crops produced)**

The livelihood systems in Mozambique change substantially between different zones. Where agricultural potential is limited, livestock, fisheries, or other income sources become important. Where poor live in agriculturally productive zones, the lack of access to land and other productive assets may leave them working the fields of neighbors ("ganho-ganho" labor, discussed above) as a main survival strategy, throughout the year, not just in the hungry season. In rural zones, when household members were asked about the sector of their activities, agriculture was the main activity of almost all people (95%), with only 2.6% having commercial, service or public sector employment as their primary activity.

The main source for food for Mozambican rural poor is own production in most zones of the country (Figure 1.17a), but there are surprising zones where labor income through "ganho-ganho" provides the resources to purchase food, as in selected areas of Tete (Figure 1.17b and Figure1.18) and in the south. Much of agricultural production never reaches the market, as can be seen from the income sources from sales of crops where there are limited areas with over 25% of income coming from sales (Figure1.18A). Although 80% of the poor and very poor grow maize in Mozambique, only 8% participate of them in the selling of maize, growing most maize to meet subsistence needs (MINIPLAN, UEM, and IFPRI, 1998).

In the coastal areas and along river systems, fishing is an important source of food and sometimes income. Other than ganho-ganho, off-farm income opportunities in rural areas are limited, except in the peri-urban areas with increasing vegetable and small animal production. Many households engage in petty trading, with small tables or stalls along the road, selling homemade beverages or small consumer goods. Remittances become important in the South and in the border areas with Zimbabwe, (MINSAU, MADER/SETSAN, and FAO, 2001), although recent economic problems in Zimbabwe have undoubtedly affected this source of funds for consumption.

2. **Asset profiles**

Given the poverty in Mozambique, the main asset of most rural and even many urban households is the land that they cultivate, although they what they have are use rights, rather than legal ownership. Based on 1996/97 data, researchers found the lower income quartile tended to have lower per capita land access and gross value of crop sales is 1/13 the value of crop sales for the highest income quartile (Jayne et al 2001). Other than land, agricultural production assets are extremely limited. In the south, where disease is not as much of a problem, households have animal traction and about 5% of poor households use it, although they may not possess their own animals. A surprising 20% of the poor and very poor have radios that function (MINIPLAN, UEM, and IFPRI, 1998), but that is one of the few assets commonly found.

3. Vulnerabilities and main coping strategies

The poor in Mozambique are vulnerable to the lack of employment and income generating activities (Mozambique, Government of, 2001). With high dependency ratios, low agricultural productivity, and relatively low land areas, the most vulnerable need income options off their farms, and there are not many options in rural Mozambique. There are environmental risks (drought and floods) in selected regions of the country (Figure 2.4), which affect large numbers of people as in the 1999/2000 floods.

The main coping strategies (already elaborated earlier) consist of the labor sales, consumption of wild fruits and plants, reduction in meals, reliance on donations and gifts, and finally selling of assets (MINSAU, MADER/SETSAN, and FAO, 2001). Unfortunately, the in-kind wage rates of a major coping strategy, "ganho ganho", correlate negatively with food scarcity so that when production levels are lower due to a lack of rain, the payments for work are also lower (SIMA, 2002b). Poor households have few assets to sell, and consumption is already low for these households, so in times of scarcity, these households do not have much to buffer them from food insecurity.

4. Diets of the food insecure and vulnerable

Diets of the ultra-poor and poor were evaluated based on household food expenditures on different food items from the 1996/97 surveys. The very poor depend on maize, cassava, and sweet potatoes. The poor spend more on millet and sorghum, in Tete and Manica, as well as Sofala and Zambezia. In their cropping, all households may grow these crops; the poor are less likely to sell them. The poor tend to cultivate more beans than the non-poor. Both in rural areas and for the urban poor with agricultural land, cassava is grown and rarely sold.

In the 1996/97 household analyses, relatively poorer households in the rural sample were used to estimate the percentage of total food expenditures on a range of food crops ((Mozambique, Government of, 2001). For six provinces (Cabo Delgado, Niassa, Tete, Manica, Gaza and Inhambane) over 20% of food expenditures for rural poor households were on maize. In Nampula, cassava replaced maize, with 22% of food expenditures on cassava. Beans were 8-12% of food expenditures in the same 6 provinces mentioned above. Zambezia and Sofala had fairly high maize consumption, 19% of food expenditures, with cassava (14%), beans (6%), and rice (8%) also being important. Maputo Province showed different patterns of consumption, with consumption of wheat, rice, and maize products, along with green leaves. Millet and sorghum are consumed more in Manica and Tete (6%), as well as Sofala and Zambezia (3%).

e. Linkages between health indicators and malnutrition

According to the 1997 Demographic and Health Survey data, stunting affects 36% of the children under three in Mozambique and wasting affects an additional 8% of children under three (DHS 1997 cited in MADER/DINA/SETSAN, 2002). Figures 1.5 and Figure 1.6 show an estimate of the incidence of those problems across the districts.

Disease and poor diet are two of the reasons behind stunting and wasting. Malaria, diarrhea and acute respiratory infections are responsible for 18%, 13% and 8% respectively of the deaths of children under five (United Nations, 2001). Malaria is cited as the main cause behind anemia, low birth weight, and miscarriage, and contributes with HIV/AIDS to high labor losses in

agriculture. Lack of potable water, lack of sanitary facilities and long distances for health care exacerbate disease prevalence, with parasites and other causes of dysentery. Low birth weights in babies generally reflect poor health status of the mother. For stunting in infants, poor infant diet is part of the problem. In many places, infant feeding is strictly simple maize or other porridge with no other nutritional components, such that chronic malnutrition occurs.

HIV/AIDS is becoming increasingly important. Current estimates indicate, "any 15 year old in Mozambique has more than a 50% chance of dying from HIV/AIDS" (United Nations 2001). Projections suggest that by the year 2010 the epidemic will lower life expectancy from 50.3 years to 36.5 unless the trend of the epidemic is drastically reversed, according to MADER staff (MADER/DINA/SETSAN, 2002). Adequate nutrition is considered to be one of the ways to increase the active life span of those infected, and reduce the health consequences in the short and medium term.

As indicated in the micronutrient section, certain nutrient deficiencies lead directly to specific diseases. Goitre can be avoided by iodine consumption. Iodised salt is one policy that has been implemented to avoid this problem. For vitamin A deficiencies leading to developmental problems in infants, vitamin supplements have been used in some areas, but recent efforts with orange-fleshed sweet potatoes provide a diet based alternative to solve this problem. Cyanide poisoning from bitter cassava can result in paralysis, but home-processing methods can avoid the health problems; more extension work is needed to train women on the processing needs, as the incidence of this is believed to be on the rise. Pellagra was once found in the refugee camps during the war, when the diet was highly limited and mainly maize consumed. It still occurs where a maize or cassava based diet is not complemented with other foods.

The health conditions related to various micronutrient deficiencies have been mentioned earlier, with clear indications of the need to increase consumption overall and diversity in the diet. Since most rural Mozambicans have limited market access and raise most of their food themselves, to achieve a more diversified diet, agricultural production options and diet-based improvements are needed. Quality protein maize, orange-fleshed sweet potatoes, and soybeans are some of the crops where households can improve their diets through production, and thereby reduce the occurrence of these health problems. The government and donors have developed programs to increase the production and consumption of these crops, but funding and human resources are limited. The programs reflect the focus on diet-based activities to improve macro and micro nutrient consumption and thereby improve nutritional status.

2. Structure of the Agricultural Sector

a. Agricultural production and trade trends

Mozambique has one of the highest GDP growth rates in the region, at 7.5% in 1999, and predicted average annual growth in GDP for 2000-2004 of 7.7%, with agriculture making up 30-32% of GDP in recent years (World Bank, 2001; World Bank, 2002). Floods in 1999/2000 resulted in lower than expected growth rates in GDP and agriculture for 2000, but GDP growth was expected to be above 5% for 2001. Since the signing of the Peace Accords in 1992, the agricultural sector has grown rapidly, as farmers were able to return to their lands, and markets began to open up, providing an outlet for surplus production. An indicator of this growth is the fact that domestic production as a source of basic food grains has gone from 56% to 78%, while

food aid has gone from 44% of total supply to less than 5%. Commercial imports make up the difference in needs (FAO, 2002).

Value added in agriculture has been increasing over time in the smallholder sector, reaching US$1 billion by 1998, of which $426 million was for own consumption and the rest was sold into the market. Figure 2.1 shows the national trends in production and in area for seven major food crops from 1992/93 through 2000/2001. The notable growth early in the period has been dampened recently, primarily due to climatic conditions (floods in 1999/2000), but also market related problems. Low prices for maize, cotton and other crops during the 1999/2000 marketing year did not provide an incentive for area or productivity expansion in those crops. Table 2.1 shows the basic production trends for the main food crops, where available and Figure 2.1 a-f show the area and production trends over time for each.[6] Of 4 million hectares of cultivated land, 53% is planted in the basic food grains (mainly maize with 1.3 million hectares), another 25% in cassava, and 17% in legumes. Total area planted has been increasing, resulting in an overall upward trend in production, in spite of stagnant yields, for most crops. Groundnut area saw a recent increase in area planted (Figure 2.1f), reflecting a trend to more marketed output, but constraints on production and marketing limit growth. Mozambique is considered land abundant, with relatively low population density, with an average 1.3 hectares of cultivated land per household (Table 2.2). There is evidence, however, that land is constrained, particularly in the most productive areas, with some households depending on labor sales for food security (Jayne et al, 2001).

The Mozambican agricultural sector is characterized by a large number a small-scale producers with primarily rainfed subsistence production based on manual cultivation techniques and little use of purchased inputs (Table 2.2). The main crops in Mozambique for smallholder agriculture can be grouped into three different categories: 1) basic food crops for most farm households; 2) food crops for diversification or with regional specialization; and 3) traditional cash crops. In the first category are maize and cassava, grown by 79% and 63% of smallholder households respectively (INE and MADER, 2001). For diversification, smallholder households crop groundnuts, beans, sorghum, millet, rice, cashew, and sweet potatoes. Table 2.3 shows the percent of households growing basic food crops by farm size classification, while Table 2.4 shows the percent of land area dedicated to those crops, Table 2.5 shows the percent of land area by province dedicated to each of the main food crops, and Table 2.6 indicates the average areas cultivated in 1995/96 and in 1999/2000.

Cash crops for smallholders include traditional crops of cotton and sugarcane, and newer crops of tobacco, oilseeds (sunflower, sesame, soy) and spices (ginger, paprika). As shown in Table 2.7, during 1995/96, only 4.4% of farmers participate in the main cash crop cotton, with only 1.4% growing sesame and less than 1% growing tobacco or sunflowers. The percent of farmers growing the main cash crops has risen in the period from 1995/96 to 1999/2000, with tobacco now grown by almost 2% of farmers, and cotton grown by 6%. Paprika, while growing in importance, is a recent crop with very limited areas so far (700-800 hectares, with 2,000 – 3,000 smallholder farmers), and not specifically identified in the CAP 2001 report. Tea and sugarcane

[6] The estimates found in Table 2.1 from the Mozambique Sistema Nacional de Aviso Previo (SNAP, the Early Warning System) should be taken with caution. SNAP area estimates are combined with yield estimates to obtain production estimates (SNAP/DINA/MADER, 2002). There were found to be large differences in areas under some crops between SNAP and those from the Census of Agriculture (CAP). Production estimates of CAP are still being completed, after which the SNAP methodology may be re-visited.

are primarily grown in Mozambique using plantation/estate production systems, such that smallholder farmers may supply labor to the plantation but not produce the crop on their land.

As Table 2.2 indicates, there are regional differences in cropping patterns, that relate to climate, soils and market access. Tete, Manica, and Sofala in the center along with Niassa in the north rely heavily on maize production with 50% or more of the food cropland in maize. With the exception of Niassa, farmers in the Northern region use a combination of crops, including cassava, maize, groundnuts and sorghum.[7] Rice becomes important in Zambezia and Sofala, along with the irrigated rice scheme in Chokwe. In the South (Inhambane, Gaza and Maputo), maize is still the most important crop in terms of land area to food crops, even though maize yields are low and agro-ecological features are not conducive to maize cropping. Cassava, groundnuts, and cowpeas have at least 10% of food crop area each in the south as well. Since smallholders dominate the land area and numbers of farms, the overall results depend strongly upon the smallholder production systems.

Trade of agricultural goods has been limited, although it is increasing. In the agricultural sector, cashews provided 29% of the value of official export earnings for the country in 2000. There are unknown amounts of unofficial trade in the north with Malawi and Zambia, particularly for maize, but also for other crops (among them, beans, groundnuts, and cassava) (Whiteside, 2002). Mozambique has signed trade protocols with 13 partners in the Southern African Development Community (SADC) and has also signed the World Trade Organization protocol, although it is no longer a member of COMESA, another regional trade commission. Withdrawal from COMESA means that trade relations with Malawi become more complicated, presenting difficulties particularly for northern Mozambique.

As noted, raw cashews were the major export crop, primarily to Asia, but the sector has never regained the production and export levels of the 1960s and 1970s, when it was the largest cashew exporter in the world. With about 6% of the export world market and 60,000 MT of export, Mozambican production seems to have reached a static level that requires major investments to increase. Cashew marketing in recent years reached a high of 65,510 tons in 1996, and is currently around 58,000 tons (MADER, 2001a). A combination of production constraints (disease and aging, poorly-maintained trees) and market/industry-related constraints is to blame for static production and export earnings (Mole, 2000). This is a very controversial area, as sectoral reforms were instituted under pressure from the World Bank, including reduction in trade restrictions on raw cashews. The 1996 TIA shows that 71% of the total cashew marketed came from two provinces, Nampula and Gaza, with two other provinces (Zambezia and Inhambane) each contributing about 10% (MADER, 2001b).

Cotton is the other major agricultural export crop, and the sector is faced with low international prices for fiber, such that producer incentives in real terms are low. The cotton industry is also dealing with gradual liberalization, as government and the private sector negotiate new institutional arrangements to replace the geographic monopsony granted to companies in the past. While cotton firms originally produced much of the cotton in the past on company land, smallholders now produce most of the cotton, many working with outgrower schemes, in which the companies help provide inputs and technical assistance, in return for cotton production. Cotton production reached a recent peak in 1998/99 with an estimated 117 thousand tons of seed cotton (MADER, 2001a) and exports over US$30 million.

[7] Zambezia, while administratively considered in the Center region, will be considered in the Northern region here due to a combination of agroclimatic and economic reasons.

Table 2.1: Production trends for 7 main food crops

	Maize						Sorghum					
Provinces	**1996/97**	**1997/98**	**1998/99**	**1999/00**	**00/01**	**2001-02**	**1996/97**	**1997/98**	**1998/99**	**1999/00**	**00/01**	**2001-02**
Cabo Delgado	62,200	97,400	57,265	50,104	70,444	450	27,200	34,200	34,708	28,606	36,931	25,335
Niassa	175,800	173,500	144,568	121,641	134,327	121,641	23,000	24,800	23,363	25,335	29,146	63,162
Nampula	117,200	120,400	129,197	106,995	107,479	166,787	85,800	90,100	89,064	63,162	79,058	41,647
Zambezia	190,600	212,500	192,366	166,787	194,953	139,986	33,400	44,500	44,948	41,647	45,883	24,232
Tete	125,700	125,300	177,544	139,986	151,078	191,868	20,500	31,600	42,297	24,232	31,115	23,279
Manica	160,100	158,600	260,829	191,868	205,873	74,568	19,800	28,100	28,566	23,279	30,708	29,549
Sofala	64,700	71,800	105,333	74,568	79,668	83,022	32,200	39,800	40,146	29,549	41,004	12,327
Inhambane	47,900	59,800	104,466	83,022	75,921	53,728	14,800	15,000	15,695	12,327	13,172	4,056
Gaza	61,200	74,100	38,811	53,728	66,215	30,335	5,000	8,000	6,728	4,056	6,290	267
Maputo	36,800	30,200	35,699	30,335	57,305	0	900	900	835	267	480	0
Total NATIONAL	1,042,200	1,123,600	1,246,078	1,019,033	1,143,263	50,104	262,600	317,000	326,350	252,461	313,787	28,606

	Millet						Rice (paddy)					
Provinces	**1996/97**	**1997/98**	**1998/99**	**1999/00**	**00/01**	**2001-02**	**1996/97**	**1997/98**	**1998/99**	**1999/00**	**00/01**	**2001/02**
Cabo Delgado	1,700	2,200	2,194	1,718	2,165	1,096	9,600	14,100	14,386	12,115	15,871	2,271
Niassa	900	1,100	999	1,096	1,253	3,155	2,900	2,500	2,354	2,271	2,837	22,321
Nampula	4,200	4,600	4,488	3,155	3,846	7,719	27,600	27,000	24,311	22,321	24,562	88,663
Zambezia	5,500	8,400	8,414	7,719	8,258	11,781	86,100	94,200	95,405	88,663	85,564	146
Tete	9,500	14,100	19,055	11,781	13,745	7,308	100	100	134	146	123	429
Manica	6,400	6,700	8,508	7,308	9,388	7,830	200	400	438	429	525	19,074
Sofala	6,700	5,100	7,490	7,830	10,336	5,480	20,000	34,100	25,494	19,074	23,163	1,589
Inhambane	6,800	6,800	6,350	5,480	5,665	2,767	2,200	1,800	1,754	1,589	2,171	1,981
Gaza	2,400	4,500	3,780	2,767	6,946	0	24,500	10,900	16,989	1,981	8,043	2,798
Maputo	0	0	0	0	0	0	7,000	5,900	4,822	2,798	4,086	0
Total NATIONAL	44,100	53,500	61,278	48,854	61,602	1,718	180,200	191,000	186,087	151,388	166,945	12,115

Source: Sistema Nacional de Aviso Previo (SNAP), Direcção Nacional de Agricultura, MADER

Table 2.1: Production trends for 7 main food crops

Provinces	Beans 1996/97	1997/98	1998/99	1999/00	00/01	2001-02	Groundnuts (shelled) 1996/97	1997/98	1998/99	1999/00	00/01	2001-02
Cabo Delgado	17,700	26,400	27,056	22,559	25,480	32,515	10,800	15,600	15,718	12,849	14,774	17,693
Niassa	25,500	25,800	23,967	21,955	23,349	27,540	2,100	1,700	1,559	1,512	1,535	1,757
Nampula	30,500	34,900	31,462	21,057	24,418	32,483	45,500	45,200	41,291	37,819	31,907	33,318
Zambezia	18,400	34,900	34,450	29,745	30,970	32,293	17,000	21,100	20,722	18,400	19,089	18,895
Tete	12,700	15,500	18,626	10,920	12,741	16,387	4,500	5,300	16,466	3,613	5,183	4,765
Manica	1,000	1,500	2,141	1,531	2,039	1,368	2,100	2,200	2,647	2,265	2,761	1,273
Sofala	8,800	8,900	9,181	5,928	8,225	7,071	3,500	3,700	3,651	2,416	3,438	3,281
Inhambane	18,900	20,100	19,562	15,590	10,505	12,735	28,200	33,000	31,596	26,413	19,650	18,880
Gaza	13,100	16,100	15,303	8,888	11,912	10,681	7,600	10,200	8,445	6,840	7,504	6,375
Maputo	8,100	7,200	6,842	8,265	4,185	4,283	5,000	4,900	4,906	2,390	3,334	3,550
Total NATIONAL	154,700	191,300	188,590	146,437	153,825	177,355	126,300	142,900	147,001	114,517	109,175	109,786

Provinces	Cassava 1996/97	1997/98	1998/99	1999/00	00/01	2001-02
Cabo Delgado	736,800	761,000	784,495	811,701	1,011,022	1,094,983
Niassa	140,700	138,700	122,954	127,005	149,553	162,705
Nampula	2,555,100	2,654,100	2,689,261	2,451,576	2,604,798	2,272,388
Zambezia	1,351,800	1,490,600	1,461,345	1,460,200	1,592,819	1,776,340
Tete	6,200	7,000	7,545	6,318	7,313	7,643
Manica	3,400	5,400	5,928	4,904	6,553	7,706
Sofala	65,300	60,100	59,867	44,188	65,888	78,341
Inhambane	331,500	341,000	295,985	295,670	317,276	315,646
Gaza	123,200	157,300	106,643	143,339	186,686	179,404
Maputo	22,800	23,900	18,905	17,074	32,685	29,394
Total NATIONAL	5,336,800	5,639,100	5,552,928	5,361,974	5,974,594	5,924,551

Source: Sistema Nacional de Aviso Previo (SNAP), Direcção Nacional de Agricultura, MADER

Table 2.2: Summary of key characteristics of the agricultural sector, 1999/2000

Characteristics	Size of farm enterprise[1]			
	Small	**Medium**	**Large**	**Total**
Number of farm households	3054106	10180	429	3064715
Total cultivated area (ha)	3736619	67727	120977	3925324
Average cultivated area (ha)	1.22	6.65	282	1.28
Most common range of cultivated area (ha)	0.5-1.0	5-10	20-50	
Percentage of cultivated area in basic food crops	84.4	74.2	7.6	81.8
Percentage of cultivated area in horticultural crops	4.8	8.3	1.2	4.5
Percentage of cultivated area in "cash crops"[2]	4.7	5.1	30.2	4.5
Percentage of farm households with trees:				
Have cashew trees	41.6	26.6	20.7	41.6
Have mango trees	49.2	50	9.1	49.2
Have papaya trees	36.3	36.6	3.7	36.2
Have banana trees	30.2	33.4	13.5	30.2
Have orange trees	19.7	14.6	12.8	19.6
Percentage of farm households:				
With chickens	69.8	84.6	50.1	69.8
With goats	27.6	81.3	69.5	27.8
With pigs	19.6	31.8	26.1	19.7
With cattle/oxen	4.1	83.2	79	4.4
Percentage of farm households:				
Use fertilizers	2.7	11	32.9	2.7
Use pesticides	4.5	10.3	36.1	4.5
Use animal traction	10.8	71.8	64.3	11
Use irrigation	3.9	16.9	35.4	3.9

Source: Agricultural Census. 1999/2000, estimated by Department of Policy Analysis (DAP) for MADER Constrangimentos e prioridades para o desenvolvimento do sector agrario em Moçambique: A Perspectiva do Sector Público. Maputo. 2001.

Classifications: Small scale are those farms with less than 10 hectares of cultivated area, less than 10 head of cattle, less than 50 goats/sheep/pigs, and/or less than 5000 poultry. Medium scale are those with 10-50 hectares of cultivated area, between 10 and 100 head of cattle, between 50 and 500 goats/sheep/pigs, and/or between 5000 and 20000 poultry. Large scale are any farms that have one or more component higher than the medium scale limit. For irrigated land, horticultural crops, and plantations, small scale is less that 5 hectares; medium is 5 to 10 hectares; and large scale is over 10 hectares.

Table 2.3 Percent of households with basic food crops

Crop	Type of farm enterprise			
	Small	Medium	Large	Overall
	(percent of households)			
Groundnuts	40.5	53.7	18.7	40.6
Rice	20.7	8.9	10.3	20.7
Sweet potato	11.9	17.8	6.8	11.9
Pigeon peas	17.4	4.4	1.4	17.4
Bambara beans/nuts	20.9	19.7	5.4	20.9
Common beans	7.6	17.6	12.6	7.6
Cowpeas	42.5	51.1	16.3	42.5
Cassava	63.4	29.3	13.3	63.2
Sorghum	26.9	25.2	11.9	26.9
Millet	4.6	14.5	6.8	4.7
Maize	78.5	87.8	48.0	78.6

Source: INE and MADER, Censo agro-pecuário 1999-2000: Apresentação sumária dos resultados: Quadros e gráficos. Maputo, 2001.

Table 2.4 Percent of cultivated area under basic food crops, by food crop and farm enterprise type

Crop	Type of farm enterprise			
	Small	Medium	Large	Overall
	(percent of area)			
Groundnuts	10.1	12.2	5.5	10.2
Rice	5.9	2.8	23.0	5.9
Sweet potato	1.5	1.8	0.4	1.5
Pigeon peas	2.3	0.7	1.1	2.3
Bambara beans/nuts	2.7	2.8	1.5	2.7
Common beans	1.9	2.7	5.7	1.9
Cowpeas	6.6	7.6	3.7	6.6
Cassava	20.2	7.6	3.3	20.0
Sorghum	7.4	6.1	2.5	7.3
Millet	1.2	3.3	0.6	1.3
Maize	40.2	52.4	52.9	40.5
All food crops	100.0	100.0	100.0	100.0

Source: INE and MADER, Censo agro-pecuário 1999-2000: Apresentação sumária dos resultados: Quadros e gráficos. Maputo, 2001.

Table 2.5 Percent of land area under basic food crops, by food crop and by province

Crop	Province									
	Niassa	Cabo Delgado	Nampula	Zambezia	Tete	Manica	Sofala	Inham-bane	Gaza	Maputo
	(percent of area)									
Bambara beans/nuts	2.1	1.9	5.6	1.6	0.7	2.2	0.8	2.8	3.4	0.9
Cassava	11.4	26.7	38.4	23.4	2.4	3.0	3.1	22.8	17.5	17.1
Common beans	10.0	0.0	0.2	1.9	6.9	1.1	0.2	0.2	1.1	1.8
Cowpeas	3.9	3.4	7.5	3.5	6.6	4.9	3.7	10.8	11.5	14.0
Groundnuts	2.9	9.9	14.9	4.0	6.7	4.5	2.2	25.2	12.1	12.3
Maize	55.7	33.1	17.3	36.8	65.7	64.8	50.0	31.9	46.2	46.3
Millet	0.4	0.8	0.3	0.3	3.4	2.3	4.1	1.2	1.0	0.0
Pigeon peas	1.7	1.6	2.4	7.6	1.3	0.5	1.1	0.2	0.5	0.9
Rice	2.6	8.8	5.4	14.1	0.3	2.8	14.0	1.7	1.5	0.1
Sorghum	7.8	13.4	7.7	4.9	4.2	12.2	20.1	2.8	1.2	0.3
Sweet potato	1.7	0.2	0.3	2.0	1.9	1.8	0.7	0.5	3.9	6.3
All food crops	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: INE and MADER, Censo agro-pecuário 1999-2000: Apresentação sumária dos resultados: Quadros e gráficos. Maputo, 2001.

Table 2.6 Area under each main crop, 1995/96

Crop	TIA 1995/96 Total area per crop 000s ha	TIA 1995/96 Percent of cultivated area %	TIA 1995/96 Average area per household ha	TIA 1995/96 Average area for households cropping this crop ha	CAP 1999/2000 Total area per crop 000s ha	CAP 1999/2000 Percent of cultivated area %
Maize	1,676	35.7	0.86	1.08	1299	38.5
Cassava	823	17.5	0.42	0.71	642	19.0
Groundnuts	533	11.3	0.27	0.61	326	9.7
Sorghum	511	10.9	0.26	0.72	236	7.0
Cowpeas	431	9.2	0.22	0.56	211	6.2
Rice	250	5.3	0.13	0.5	190	5.6
Other beans	192	4.1	0.1	0.37	158	4.7
Millet	70	1.5	0.04	0.54	40	1.2
Cotton	66	1.4	0.03	0.76	119	3.5
Sweet potato	62	1.3	0.03	0.34	47	1.4
Common beans	59	1.3	0.03	0.47	62	1.8
Sesame	10	0.2	0.01	0.38	15	0.4
Tobacco	9	0.2	0	0.58	26	0.8
Sunflower	3	0.1	0	0.76	6	0.2
Total	4,697	100			3376	100

Source: Inquérito Agrícola ao Sector Familiar, MAP,Mozambique 1996 and Censo Agropecuario 1999/2000, INE/MADER.

Note: In the CAP, there are 310,573 hectares of "cultivated area" that are under fallows and without crops at the time of the survey, or with permanent crops on large farms. Also areas under horticultural or tree crops with smallholders are not included.

Table 2.7: Crop production, marketing and participation of households in markets in 1995/96 and 1999/2000

	1995/96				1999/2000		
Crop	Percent of hhs growing this crop 1995/96	Percent of hhs harvesting this crop	Percent of hhs selling crop	Percent of crop production sold	Percent of hhs growing this crop 1999/2000	Change in % of households from 1995/96 to 1999/2000	% change in % of households
Maize	79.1	76.8	21.3	19.5	78.6	-0.5	-0.6
Cassava	59.0	54.8	6.9	6.4	63.2	4.2	7.1
Groundnuts	44.1	41.4	15.2	28.4	40.6	-3.5	-7.9
Sorghum	36.1	33.7	2.0	4.2	26.9	-9.2	-25.5
Cowpeas	39.5	33.5	4.4	12.2	42.5	3.0	7.6
Cashew	43.0	29.1	16.7	49.1	41.6	-1.4	-3.3
Rice	25.8	24.3	3.5	9.4	20.7	-5.1	-19.8
Other beans	26.5	23.2	4.1	24.7	20.9	-5.6	-21.1
Coconut	20.0	13.5	5.5	40.1	na	Na	
Millet	6.6	6.3	0.3	0.6	4.7	-1.9	-28.8
Sweet Potato	9.4	5.9	1.4	27.7	11.9	2.5	26.6
Common beans	6.4	5.2	2.2	35.3	7.6	1.2	18.8
Cotton	4.4	4.5	4.5	100.0	6.1	1.7	38.6
Sesame	1.4	1.6	0.2	1.7	2.5	1.1	78.6
Tobacco	0.8	1.5	1.0	100.0	1.9	1.1	137.5
Sunflower seeds	0.2	0.4	0.0	4.1	0.8	0.6	300.0
Sugarcane	na	na	na	na	2.3	na	na

Source: For 1999/2000, Censo Agro-pecuario (CAP) 1999/2000; for 1995/96, Trabalho do Inquerito Agricola (TIA) 1996.

Note: For "Other beans" in 1999/2000, pigeon peas and bambara beans/nuts had at least 20.9, but possibly more when combined, so the estimate here is a minimum.

Sugar is another major cash crop and production potential is high, given agroclimatic conditions (Wandschneider and Garrido-Mirapeix, 1999). Sugar cane was an important crop for Mozambique in the 1970s when production reached 325,000 MT but current production is about 75,000 MT. Current government strategy is to encourage investment in the estates and mills, such that the main poverty reduction effect would be through demand for labor, rather than cropping of sugarcane (MADER, 2001), although there are a few pilot outgrower projects. The sugar is primarily for domestic consumption or export under special agreements (e.g. quota system for export to the United States), operating in a protected environment with high sugar import duties for the present. Swaziland is a major sugar producer in the region, and an unknown proportion of domestically available sugar comes from informal or illegal imports of sugar through Swaziland or South Africa.

Many agents are working to identify potential cash crops for Mozambican farmers, particularly for export. Paprika is increasingly grown in the north for export; a new pigeon pea factory is being installed in Zambezia to process pigeon peas for dhal exports to the Middle East and India. Sesame seed and tobacco are also increasing for export. The European Union and USAID are funding a range of activities to identify cash cropping alternatives for exports within the southern Africa region, as well as to Europe, Asia, Middle East, and North America. Mozambique has not taken much advantage of the African Growth Opportunity Act (AGOA) that offers trade incentives with the United States, with incentives for textiles and agricultural products. In addition, SADC trade protocols offer advantages for regional trade.

b. Spatial distribution of major crops produced

1. Crop distribution, agro-climatic conditions and crop suitability

Maize is grown as a principal crop in almost all of Mozambique, as can be seen by Figure 2.2a, showing the distribution of maize cropping, based on the district level rapid appraisals. Only a few places in the country lack maize cropping. Cassava is also fairly well distributed as a principal food crop, with the exception of Tete and northern Manica Provinces (Figure 2.2b). Millet and sorghum were combined for Figure 2.2c, and are also found throughout most of the country, with the exception of the extreme south. Rice is as a principal or secondary crop along the coastal zones and in much of the north, either irrigated rice (south and some in Zambezia), lowland rice in Zambezia and some upland rice in the northern regions (Figure 2.2d). Sweet potatoes (primarily traditional varieties) are found as a principal crop in only a few districts, yet it is a secondary crop in most of the country (Figure 2.2e). Bambara nuts, cowpeas, groundnuts, and pigeon peas are grown throughout the country, although they do not figure as principal crops in the district profiles. The distribution of the crops does not always reflect ideal growing conditions for the crops, in terms of rainfall, soils, and altitude.

Mozambique is a vast country, showing a great variation of soil types, altitude, temperature, rainfall pattern and other climatic factors. By and large, the climatic pattern in the northern and central part of Mozambique is strongly influenced by the movement of the Inter-tropical Convergence Zone with a well-defined rainy season, whereas the southern part is mostly influenced by the sub-cyclonic system with low-pressure centers that gives rise to an erratic rainfall pattern. Based on a moisture index, using mean annual rainfall and mean annual evapotranspiration, Reddy (1986) defined five broad climatic zones in Mozambique, namely arid, dry semi-arid, wet semi-arid, sub-humid and humid (Figure 2.3). Arid and semi-arid zones are mostly concentrated in the southern part of the country and southern Tete, with the arid zone

confined to the western most part of Gaza province, whereas the wet semi-arid and sub-humid climatic zones dominate the central and northern parts of the country. The humid climatic zone occurs in the highlands of the central Provinces of Zambézia and Manica.[8]

Prolonged drought spells are also a very common phenomenon within the country affecting large areas of crop production and leaving thousands of rural families under conditions of food insecurity (Figure 2.4). However, the importance of drought varies across the country, by and large, decreasing in severity from south to north, following an opposite trend to the amount of rainfall. The intensity of drought is particularly severe in arid lands confined to the western most part of agro-ecological region III in Gaza province, where mean rainfall is lower than 500 mm per year (Figure 2.3). The farming system in this area is based on livestock (cattle) and, although unsuitable for agriculture, farmers still grow sorghum and pearl millet.

A substantial part of rainfed agriculture is practiced in the semi arid tropics, which comprise both dry and wet semi-arid, which together represent around 80% of the total area. The dry semi-arid areas comprise agro-ecological regions I in Maputo province, regions II in Gaza province, III in Inhambane province and also parts of region VI and VIII in northern Tete and parts of the coastal belt of Cabo Delgado and Nampula (Figure 1.4). Annual rainfall in these regions varies from 500 to 800 mm, with one short growing season from November to February/March, but rains can also occur during the cool season in regions I and II, which is of benefit for cassava and cashew crops (Figure 2.3). Crop yields are generally low with high risk of crop failure and, due to the short growing season, farmers grow early maturing varieties. There is also a need for water harvesting and conservation techniques. Farming systems include extensive livestock production (region III and VI) and intercropping based on sorghum and millet, which prevails in regions III and VI. The cropping systems also include cowpea, groundnut and pockets of cotton (Region VI), with no or very little cassava grown in region VI. Although there is little potential for dry land maize, the crop is grown in regions II and I intercropped with cowpea and, intercrops of cassava and groundnut being cultivated in soils with light texture. Rice and sweet potato, particularly in the lowlands and vegetables are also important crops for regions II and I. In agro-ecological region III, in Chokwe area (Limpopo basin) there is also a large irrigation scheme (surface) with a potential to irrigate 20,000 hectares of land, mainly for rice production. Currently the irrigation scheme is under rehabilitation with the financial support of the French and Japanese governments.

The major part of semi-arid tropics is classified as wet semi-arid, comprising parts of agro-ecological region II along the coastal belt, parts of regions IV, VI and X, all regions V, VII and IX and a substantial part of region VIII (Figure 1.4). The amount of rainfall varies substantially, ranging from 600 to 1200 mm with a general high evapotranspiration rate, moderately warm to warm temperatures, with soils varying from sandy to heavy texture and altitudes from 200 to 1000 meters (Figure 2.5). In these regions crops also experience drought stress, especially intermittent moisture stress, which can be particularly severe when stress coincides with the flowering stage. By and large, intermediate to late maturing varieties are appropriate for most of these environments but early maturing varieties are also important for some of the environmental niches and for late planting. Cropping systems in the wet semi-arid consist of various intercropping systems of maize (grown in two seasons in region II), cassava, sorghum, cowpea, groundnut (especially in regions II and VII), sweet potato and pigeon pea, particularly in region VII, where it is mostly grown as a sole crop. Rice is mostly grown in wetlands, being of particular importance for region V where it is grown in heavy soils in which, water

[8] Crop suitability maps for maize, cowpea, sorghum, cassava, and irrigated rice can be found in the Annex.

management (harvesting and drainage) is of major importance. Millet is mostly grown in region VIII and together with sorghum in the northern parts of region IV, where the rainfall varies from 600 to 800 mm and, banana being an important cash crop in this region IV. Sugar cane is also grown in large commercial farmers in regions V and II and is a significant source of income for small farmers contracted to grow the crop. Cashew production is an important income for farmers in region II, along the coastal belt in Inhambane, and also for farmers in the most eastern part of region VII, where cotton and to a lesser extent tobacco (also in region IV) are important cash crops too.

Sub-humid and humid zones comprise areas confined to medium to high altitude regions in the provinces of Manica, Zambezia, Nampula, Niassa and Tete in parts of the agro-ecological regions IV, VII and X, with mean annual rainfall higher than 1000 mm but exceeding 1400 mm in the humid zones (Figure 2.3 and 2.5). In these areas drought spells can occur for short periods, but usually the rainfall pattern is reliable. Intermediate to late maturing varieties are suitable for these environments. Maize dominates the cropping systems, which also includes sorghum, beans and Irish potato, this latter crop being important income in areas of Lichinga and Angonia in Niassa and Tete provinces respectively.

2. Cropping, poverty and malnutrition patterns, agro-ecological zones, population density, and market density

Table 2.5 shows area by province for each of the main crops as found in 1995/96 with the TIA and in 1999/2000 for the CAP, as well as the average area under each crop for the households in 1995/96. Figure 2.4 shows the areas under risk of floods, drought, or both. Combining this information with the poverty maps in the previous section demonstrates that poverty is prevalent in areas of flood risk, but elsewhere as well. Looking at different agroecological zones, according to INIA (Figure 1.4), poverty is concentrated in the low altitude zone of Zambezia and Sofala, and coastal areas south of the River Save. Looking at Figure 1.4 and Figure 1.14, with the numbers of people indicated, the Beira Corridor has high poverty numbers, but cuts across agroecological zones. Parts of the zone have risks of drought or flood or both. There are problems with low birth weight babies, infants with low weight gain, and Vitamin A deficiency, in particular. Sofala has 9% of the total population of Mozambique, but it has 11% of the poor.

Iodine deficiency and generally poor health indicators accompany Vitamin A deficiencies in Niassa and Tete Provinces. These are zones where a high proportion of household income comes from labor sales, and not that much comes from crop sales. In addition, the basic food crops are not as diversified as in other areas, with maize being the main food crop, such that pellagra is more evident. These are, for the most part, not densely populated zones, so the actual numbers of poor are reduced.

Zambezia and Nampula are densely populated, and while they do not have the highest incidence (percent) of poverty, they do have the highest numbers of poor, with 40% of the national total of those living below the poverty line (MINIPLAN, UEM, and IFPRI, 1998). Production and diet tends to be more diversified and there are increasing market opportunities, but substantial numbers of people live beyond the reach of transport and markets, as well as other services. Most of food consumption comes from own production, with crop sales an important source of income, along with labor sales in the western parts.

The problems with konzo (caused by cyanide poisoning from inadequately prepared bitter cassava) are geographically limited to regions where bitter cassava is grown in Nampula Province. Other nutritional problems are evident in the coastal zones, with low infants weight gains, low birth weight babies. These are also areas of high poverty numbers, and heavy reliance on cassava, although the percentage in poverty is not as high as in some areas of the south and center. Labor sales are not a major source of income for households and many households must rely on the market for over 50% of their food consumption.

In the South, the relatively large populations in the coastal areas and to the west live in poverty (Figure 1.14), and depend on crop income for much of their income Figure 1.18). Soil fertility decline is relatively high in these zones (Figure 4.1), while just in from the coast, the risk of drought is high (Figure 2.4). Under these conditions, crop income is not sufficient to bring the people out of poverty.

In a recent study on poverty and well being in Mozambique, looking at rural households using econometric methods, researchers found that the poor were more likely to crop maize, yet less likely to participate in sales of maize to markets (Table 2.23 in MINIPLAN, UEM, and IFPRI, 1998). The poor were less likely to grow cassava, and also less likely to grow cotton. The former may be due to lack of land for a relatively low value crop, whereas the second might be due to lack of access to inputs to grow cotton. Table 1.3 shows that higher poverty rates occur in the provinces with higher climatic risks in the Center and South of Mozambique, particularly Tete, Sofala and Inhambane. In recent work by Simler and Nhate (2002), poverty maps were developed to show where there are concentrations of poverty. Figure 1.11 and 1.12 shows the district level percentage of households in poverty, with high percentages in southern and central areas of the country. When that is analyzed by administrative posts, it is evident that within districts there are areas of poverty and areas that are relatively better off. Looking at the numbers of poor, the Beira corridor zone, selected zones of Tete, Nampula and Zambezia (with high populations), and the southern coastal belt have the greatest share of the poor in Mozambique. A major point of the Simler and Nhate (2002) analysis, however, was to indicate that inequality in income and asset distribution is strong at a local level, with poor households and relatively better-off households living as neighbors. A substantial amount of the variability between households cannot be explained by using provincial, district or administrative posts information. Jayne et al. (2001) reached a similar conclusion.

3. Yields patterns

With the exception of cassava, yield trends have been basically flat over the past eight years, although in a good rainfall year, such as 1998/99, yields are generally higher than other years, as can be seen in the figures.[9] Table 2.8 shows the provincial level trend in estimates for each of the basic food crops included in the National Early Warning System (Sistema National de Aviso Previo, SNAP) database (SNAP/DINA/MADER, 2002). Table 2.8 also shows a comparison between the yields estimated by SNAP for 1995/96 and those found in the 1996 TIA household survey for the same year. For almost all the food crops included, the SNAP value is around 100% greater than the TIA estimate. For example, for maize, the 1995/96 estimated average yield for maize was 878 kgs/hectare, whereas for 1996 TIA it was only 483 kgs/hectare.[10]

[9] The statistics on yield should be used with caution as the methodologies involved with crop cuts and field observations are subject to errors. SNAP with FAO assistance will be re-evaluating the methodologies used.

[10] Given the importance of maize in the food system in Mozambique, it is important to compare the 2000/2001 SNAP estimates with those of the Agricultural Census (CAP), to see if major differences persist between the yield

Cassava is the one crop that displays increasing yield trends, across the provinces, according to the work of the SNAP team. This cannot be explained by fertilizer use, but may be related to the distribution of improved cassava roots. As noted in the recent SNAP report, the yield increases are now threatened in some area by the presence of brown streak virus, particularly in the coastal areas of Zambezia and Nampula Provinces. Given the differences in yield estimates between SNAP and TIA for cassava, caution should be used in interpretation, as measurement of both area and production is subject to error, particularly for root crops.

The actual yields in Mozambique are much below the estimated potential yields and other yields in the southern Africa region. Howard et al. (1998) use several sources in determining the ranges of actual and potential in Mozambique: maize: 0.14 – 1.3 tons/ha actual and 5 – 6.5 potential; sorghum 0.3 – 0.6 tons/ha actual and 0.8 – 2 tons/ha potential; rice 0.5 – 1.8 tons/ha actual and 2.5 – 6 tons/ha potential; beans 0.3 – 0.6 tons/ha actual and 0.5 – 2.5 potential; cassava 4 –5 tons/ha actual and 5-10 tons/ha potential; cotton 0.3 – 0.6 actual and 1-2 tons/ha potential.

Climatic conditions can be very important in yields. In 2001/2002, the National Early Warning System at the Department of Agriculture in MADER highlighted high numbers of families affected in Gaza, Inhambane and Maputo Provinces with over 26,000 households and almost 55,000 hectares of crops affected by drought (SNAP/DINA/MADER, 2002). Yields in the South for maize were 0.43 tons/ha, for sorghum 0.44 tons/ha, for beans 0.28 tons/ha, and for groundnuts (shelled) 0.26 tons/ha. For the North, yields were 0.97, 0.63, 0.44 and 0.49 for maize, sorghum, beans, and groundnuts, respectively, as these zones were not affected by the drought conditions found in the South and elsewhere in Southern Africa.

4. Cropping systems for main crops

For all crops throughout the country, manual cultivation systems are prevalent, with rotation and intercropping. In some areas, two crops per year are possible, with different crops, according to the season. The main cropping season is September-October through March-April, the rainy season (Tickner et al, 2001).[11] With rain in May, a second crop can be planted in the dry season, or with irrigation in selected areas. Most farmers cultivate several different plots; some plots may be near the homestead and others quite a distance away. In 1996, only 1% of farmers use fertilizers and 5% used insecticides (TIA, 1996). For seeds, 57% of seeds were from own production, with another 18% locally obtained, and only 1% purchased seed. Outgrower schemes provided seeds and other inputs for some cash crops, including cotton and sesame. More recent data from the CAP (INE and MADER, 2001) shows that 2.7% of small-scale farmers are using fertilizers and 4.5% are using pesticides.

Intercropping and rotational cropping are commonly used, although there is no documentation on the number of households or land area under such cropping systems. The systems identified by Tickner et al. (2001) for northern Mozambique include groundnuts with sorghum, pigeon peas, or cassava; cassava with pigeon peas or cowpeas, and additionally bambara nuts or sesame; and maize with cowpeas, sorghum, pigeon peas, and/or pearl millet.[12]

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estimated with the different methodologies. This could have important implications for the Food Balance sheet and other national analysis on production and consumption.

[11] Appendix 8 in Tickner et al. (2001) provides a cropping calendar for the basic crops grown in northern Mozambique. No similar work was found for the central and southern regions.

[12] Their analysis of financial returns indicated that for the northern region, groundnuts combined with long duration crops such as cassava and pigeon pea were highly profitable. They recommended growing crops such as maize rice,

The CAP shows animal traction used primarily by farmers in the south and center of the country, with distribution of animals related to pest and disease problems. Nationally, an average of 11% of smallholders use animal traction, but that ranges from 49% in Gaza to less than 1% in Nampula, Zambezia, Cabo Delgado, and Niassa (INE and MADER, 2001). The medium and large scale farm enterprises in the south and center are much more likely to have animal traction than their northern counterparts.

Irrigated production is primarily confined to peri-urban production with vegetables and irrigated rice in selected zones. Only 4% of the farms use irrigation for production. FAO indicates irrigation potential for 3.3 million hectares in Mozambique (FAO, 2002), with only 40,000 hectares currently irrigated, and not all of that functional. Rehabilitation began in 2001 of a relatively small-scale irrigation scheme (150-250 hectares) in Zambezia (Mucelo scheme), based on rice cropping with other crops on a seasonal rotation.

Rice is primarily cultivated in a rainfed lowland ecosystem, with a minimum of water control needed in some in flood areas, in Zambezia Province. Rice cultivation in the lowlands is often based on transplanted seedlings, and demand additional labor with weeding, making it fairly labor intensive. No purchased inputs are used in the production, and seeds are retained from own production. The traditional varieties are generally long duration varieties (150 days), and only one crop per year is grown, with other crops (including sweet potatoes) grown in the residual moisture (de Moor, personal communication, 2002).

Within the cropping systems, there may be labor divisions by gender for the crops, such that women are primarily responsible for food crops, while the men are responsible for the cash crops. There are also certain activities that tend to fall to the men (clearing new land and soil preparation) and to the women (tending small livestock, gathering firewood and water), although some of these lines are blurred, depending on labor availability in the households. Hired labor is used, frequently in the form of "ganho-ganho" in which laborers receive in-kind payment for work (usually maize or other food crop) or labor time is paid back with neighbor's time at a later date. This is the main source of off-farm income for the rural poor.

Purchased inputs are most commonly found in cash crop production, particularly cotton and tobacco, and for production of horticultural crops. For cotton, pesticides are recommended and outgrower provision of products on credit is used to ensure that farmers use them.

5. Primary uses of crops

Patterns of home consumption and marketed surplus vary substantially between regions and commodities.[13] In general, marketed production is low as a percentage of total production for basic foods crops. As shown in Table 2.7, among the basic food grains, only maize is commonly marketed with about 20% of total production sold, and 21% of households participating in the markets for maize.

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sunflower seeds and pigeon peas only in some sort of intercropping system, but not in high intensity sole cropping with purchased inputs (Tickner et al., 2001).

[13] For the analysis of marketed surplus, the 1996 TIA data have been used. The 2002 TIA currently being conducted will serve to indicate whether or not market participation for the basic food crop has changed in recent years.

Maize is generally processed into a maize porridge, either by soaking and hand pounding or grinding at a local hammermill into a straight-run product. In zones where maize production is low or in urban areas, processed maize meal may be purchased in retail shops and markets from the production of the large mills in Maputo, Beira, or Nampula. Maize grain may be stored throughout the year on farm, although there are thought to be heavy storage losses due to pests (rats, weevils, etc.).

Other crops show even lower participation rates in sales markets. Rice, for instance, has only 3.5% of households participating in selling rice even though 26% of households grow rice, and only 9.4% of the total production is sold. In Zambezia, the province with the greatest rice production, (53,000 MT out of the 115,000 MT produced in the country), 49,000 MT (92% of provincial total) is consumed in the homes of the producers, and only 4,000 MT is marketed. In Gaza, where much of the rice is grown in the irrigated schemes of Chokwe, almost 30% of production is marketed, but only 4% of the population participates in rice cropping, and only 2% in rice marketing.

Cassava is produced mainly for home consumption, with only 6% of the crop sold. It can be found in the markets in dried chunks, but rarely is processed into chips or flour for sale in Mozambique. Consumption in the home, however, is based on either boiled pieces in stews or a type of porridge made from pounded cassava. The bitter cassava must be peeled, soaked and dried in a time-consuming process, necessary to extract the toxic elements. Once harvested, cassava is generally not stored on farm, but either sold or eaten. Cassava and other tubers are advantageous for they are less subject to theft than other crops, as well as being stored in the ground for periodic harvest on need.

Pigeon peas have traditionally been grown as a subsistence crop in intercropping systems and then eaten at home as a freshly cooked vegetable or in stews. Only recently has trade with Malawi for dhal processing turned this into a cash crop for northern farmers. A new processing facility in Zambezia hopes to begin operations in 2002 or early 2003 to process pigeon peas and other pulses for export, but until then, production for export is limited.
Oilseeds are produced in limited quantities. Farm households use small-scale presses to produce oil for household consumption as well as for local sales, using sunflower seeds primarily. There are some recent difficulties in profitability of this activity, as farmers are finding sesame seed cultivation and sales of seed more lucrative than growing sunflowers and producing oil (Russel, personal communication, June 2002). Sales for the domestic oil industry (apart from cottonseed) are small, as industry can rely on edible oils that arrive as food aid. Gordon and Langworthy (1999) note that in 1999, the Monapo processing plant purchased on 230 tons of oilseeds, while the Beira plant bought about 250 tons of sunflower seed and 130 tons of sesame seed, so there is some industrial purchase.

6. Primary constraints and purchased inputs use[14]

Agricultural growth has occurred in Mozambique in spite of all the constraints on farmers, particularly in the input and output markets. A MADER team recently cited seven principal constraints on overall agricultural sector growth: 1) lack of access to markets; 2) lack of access to improved technologies; 3) lack of access to credit, as well as high cost of credit; 4) rigidities in the access to and use of land; 5) lack of healthy and trained human resources; 6) lack of organizational capacity; and 7) vulnerability to natural disasters (MADER, 2001a). As noted by

[14] This section relies heavily on the work by Tickner et al. (2001) for northern Mozambique.

Heltberg and Tarp (2001), "to achieve pro-poor rural growth it is therefore essential to address explicitly the conditions of high-risk, low productivity and low capital endowments of poor farmers." These constraints are evidenced in farm level activities and can be particularly acute for selected crops and will be discussed further.

Constraints for maize are mainly lack of access to improved varieties and to fertilizers, high variability of prices in the market, and problem with pests in storage (weevils and rats). Yields will remain below one ton as long as fertilizers are not accessible for small farmers.[15] Currently there is little fertilizer use on maize, and such use would be risky given producer price variability and market instability, as well as climatic risk. Sasakawa 2000 (SG2000) and the National Extension Service have conducted an extension program with high input intensity cultivation, with improved seeds and inorganic fertilizers, using crop management practices to improve yields. Analysis of this program shows that such high input use may be profitable for farmers, but much depends on getting a good price for the output by selling several months after the harvest, as well as a low price for the inputs (Howard, et al., 1998). Quality protein maize (QPM) is being grown in Mozambique, but with the lack of price incentives and grading systems in place, the demand will be limited. Availability of the seeds becomes a constraint in areas where the maize has been grown in demonstration plots or with farmer/extension programs.

For rice, water control is a major difficulty for many farmers and irrigation systems are one of the main ways that the government envisions increasing production of rice (Mozambique, Government of, 2001). In Chokwe in southern Mozambique, large-scale public irrigation schemes have been the major emphasis in the past under state control, but much of the land is now under control of small-scale farmers. The irrigation schemes have not been well maintained and are not currently very productive. In 1973/74, over 65,000 MT of paddy rice were produced in Chokwe, compared to about 4,000 MT in 2000/2001 (Perreira, et al., 2001). In Zambezia Province and parts of neighboring provinces, there is extensive small-scale rice cropping, with limited water control systems in low-lying areas. Rice is cropped for a single season and then sweet potatoes or other crops are planted at the end of the season with the residual soil moisture. One of the problems is the relatively high labor demand of the crop, especially for transplanting and weeding, as well as the vagaries of water control. Due to labor constraints and other land uses, it may be difficult to move to double cropping with shorter duration varieties, but such varieties are unavailable in Mozambique at any rate. Another constraint related to the marketing is the quality of seeds and the lack of improved varieties for higher yields and better rice quality. There is an aromatic variety locally known as Chupa that farmers appreciate in spite of relatively low yields (Branco, personal communication, June 2002), but there is currently no market mechanism to capture the benefits of a higher quality rice. The national poverty reduction strategy (known as PARPA) envisions investments in small-scale irrigation and village level training on control systems to assist with the water constraint (Mozambique, Government of, 2001). In the north, there is some dry land rice production in the zones of Ribaue, Malema and Gurue, but the potential has not been developed and varietal development is needed.

Sorghum and millet production have grown fairly steadily since 1992/93, although the climatic problems of 1999/2000 affected total production. Sorghum and millet are generally not marketed, other than when processed into traditional beverages and sold. The lack of new

[15] The accessibility of fertilizers and other inputs will be discussed further in the inputs section.

varieties means fairly low yields and the lack of market mechanisms reduced demand for surpluses.

For cassava, farmers in the coastal areas of Nampula and Zambezia Provinces are facing brown streak disease, for which researchers are seeking resistant varieties as well as cropping practices that might minimize the losses. In addition, cassava-processing technology is not widely distributed and there are difficulties with bitter cassava and cyanide poisoning that proper processing can eliminate. Distribution of improved cassava varieties can assist with these problems, but the private sector has not been involved and has shown little interest in involvement in cassava varietal distribution, so the public sector works with NGOs for distribution. The private sector is involved however in the development and diffusion of cassava processing equipment, both small and medium scale, which shows potential for further development.

For pulses and oilseeds, one of the problems in developing market outlets is the lack of high quality seeds and the right varieties to guarantee commodity needed for trade. Sesame is an example in which efforts are increasing to make the white sesame seeds available, since that is the type of sesame that sells well in Asian markets. Local varieties receive lower prices in the markets. For sunflower, the local seed has degenerated and needs to be replaced to ensure high oil content, and little Black Record seed is available. There are pigeon pea varieties with different durations, but they are not widely known in Mozambique, so mostly the long duration pigeon pea is grown, although the highest market demand in Asia would fall at the time of harvesting short duration varieties. There are insect pests for the oilseeds, particularly sesame and castor, as well as the pulses, including pigeon peas.

Sweet potatoes are a relatively minor crop currently, but are gaining in importance. Government and NGOs have formed partnerships for the promotion of orange-fleshed sweet potatoes to ameliorate Vitamin A deficiencies. These programs represent an effort to use diet-based approaches for vitamin deficiencies and the constraints are generally in supply of the planting materials and in development of processing and consumption habits for this sweet potato. About 28% of the sweet potato is marketed and so it represents an income diversification crop in some areas.

For the spices, including ginger and paprika, farmers need technical assistance for these relatively new crops. Quality seeds or planting materials are needed and then market outlets would need to be developed, as the market is fairly thin at present. For paprika, there is one main buyer, Cheetah, who has been doing extensive promotional work on the crop in coordination with NGOs in the north. Price is conditional on quality. Given the lack of quality-based pricing for most crops, farmers will need to adapt to this reality of the marketplace, although it will not be without difficulties. Technical expertise is the critical element and there are risks with a monopsony market, so NGOs are helping to overcome the market coordination problems and the weakness of farmer associations for bargaining with market agents.

c. Farm size and structure

1. Farm size distribution

There is only limited information from the 2000/2001 Agricultural Census, but it does provide an overview of the agricultural sector and land use (INE and MADER, 2001). Over 99% of

households have less than 10 ha with an average of 1.22 ha cultivated area per household; 86% of farm households have cultivated land areas under 2 hectares per household. Of the total cultivated area, 95% is in the hands of smallholders with less than 10 hectares. There is very little in the way of large-scale commercial agriculture and the dual agriculture found in Zimbabwe, Zambia and other countries in the region does not exist in Mozambique. For the main food crops, only 3% of maize and 6% of rice is grown by the large-scale commercial sector. The small and medium scale farmers dedicate most of their land to the basic food crops, whereas the large scale farmers dedicated more land to cash and tree crops, as well as pasture. Large-scale farmers may grow food crops to provide maize and other staples to workers, and the area is generally limited. Based on a limit of 10 hectares of cultivated land area for small farmers, the data show that, with an average of 1.2 hectares of cultivated land, 79% of smallholders cropped maize and 63% cropped cassava, the two most common crops (see Table 2.7) (MADER, 2001b).

2. Geographical distribution of farms by size and by subsistence vs. commercial orientation

Larger farms in Mozambique tend to be in the zone where animal traction is possible or where market access for sales is reasonable (Figures 2.6 and 2.7), or where population pressure on the land is less. Figures 2.8, 2.9 and 2.10 show the number of small, medium and large-scale farms in each province, according to the recent CAP. Manica, Gaza and Maputo provinces have the highest numbers of large farms, whereas Zambezia and Nampula have large numbers of small-scale farms. Average cultivated area for small-scale farms is 1.22 hectares, for medium-scale farms, it is 6.6 hectares, and for large-scale farms, it averages 282 hectares. There are only 429 large-scale farms in the country, compared to 3 million small-scale farms and 10,000 medium-scale farms (Table 2.1). Women headed households are disproportionately in the smaller farms, particularly those below 2 hectares of cultivated area (INE and MADER, 2001). A total of 23% of farms in Mozambique have female household heads, but of the farms less than 1 hectare, 28% are headed by women, and of the farms greater than 5 hectares, 14% are women headed households. The female-headed households tend to be more in the South, Gaza, Inhambane, and Maputo Provinces having 30-36% female-headed households whereas in Nampula, only 16% are women headed.

Most Mozambican farmers have a subsistence orientation, throughout the country. Although production information from the 1999/2000 CAP is not available, an earlier survey of farm households in 1995/96, TIA96, found that, for the main food crops, the majority of the crop went for home consumption: 96% of sorghum, 94% of cassava, 88% of cowpeas, 80% of maize and 71% of groundnuts, so most small scale farms are subsistence orientation. Table 2.1 indicates some of the difference between the different types of farms. In the South, medium and large scale are likely to use animal traction, but not so in the north due to disease problems.

The southern part of Mozambique is usually deficit on food production and there are limited options, due to a combination of environmental risks, particularly drought and selected areas with flood risks or combined risks (see Figure 2.4). Roads and other infrastructure are good in some areas, such as near Xai-Xai, with substantial trading activities. Yet infrastructure is unreliable in other areas, such as near Chicualacuala in Gaza, where market opportunities are reduced. It does mean that some emergency distribution of seeds and plant material for sweet potatoes and cassava will help to disseminate new varieties in the region. With the exception of rice in Gaza, average yields for most food crops are lower in the southern provinces than in the

central and northern provinces (Table 2.8). In the south, sales of traditional beverages are often the most important source of household income. There are limited sales of maize and cashew in the south, but often the poor do not have enough production to sell, so they sell their labor to their better-off neighbors. The provincial level analyses for Gaza, Inhambane and Maputo Provinces suggest that animal sales may be the best option for the poor if they can find to resources to obtain animals. Agriculture is considered more risky and less remunerative than other activities.

In the center, access to the market varies widely, from good access near Chimoio and along the Beira Corridor, to virtually no access in parts of Tete and southern Manica and Sofala (Figures 2.6 and 2.7). Given climatic risks, farmers tend to have subsistence production focus, selling if they have a surplus and if there is a trader.

In the north, there are areas of very poor access and mainly subsistence production in Niassa, whereas in Nampula there are areas of intensive market activity and sales. Much depends upon the road infrastructure and presence of traders to provide inputs or purchase production (Figures 2.6 and 2.7). With the lack of animal traction, many of the large farms are mechanized.

3. Cropping emphasis by size of farm

The cropping of the smallholders varies from that of the medium and large farms in several ways. Cassava is generally grown by smallholders, with only 13% of large farms cropping cassava, compared to 63% of small farms and 30% of medium farms (INE and MADER, 2001). Large farms are much more likely to use fertilizers and pesticides and have investments in animal traction (in the south), and irrigation. The majority of both medium and large farms have cattle or oxen, compared to only 4% of the small farms. The large farms are much more likely to have substantial land in cash crops, with 30% of land on average dedicated to these crops, compared to only 5% of land for small or medium farms. Both small and medium farms allocate most of their land to basic food crops, with 84% on average for small farms and 74% on average for medium farms.

d. Purchased inputs

Purchased inputs are in very limited supply and use in Mozambique. In the early 1980s, with a strong state farm sector, fertilizer imports were 40000-60000 metric tons per year, and pesticides reached 2-3 million liters. Mozambique has one of the lowest use rates in sub-Saharan Africa, with an estimated average annual application of 1.84 kg nitrogen—phosphorus-potassium (NPK) fertilizer applied per hectare of arable land, compared to an average of 16.55 kg/ha for West Africa and 8.89 kg/ha for all of Sub-Saharan Africa (Naseem and Kelly, 1999). There have been dramatic changes in fertilizer and other input supply and distribution systems since the time of Independence and even since the Peace Accords were signed. Previously, all imports were channeled through the parastatal Interquimica and then the parastatal Boror was responsible for domestic distribution of chemical inputs. For seeds, SEMOC, the parastatal enterprise, was responsible for production of seeds, import of seeds (when needed) and distribution and sales of seeds.

1. Sources of inputs

There is no domestic fertilizer or pesticide production capacity currently in Mozambique, although there is one fertilizer plant that operated in the 1960-1980s in Matola, the Empresa Quimica Geral, which stopped operations in 1983. Rehabilitation of the plant would cost an estimated $10-15 million and is seen to be unrealistic unless Mozambique were to begin to use its own raw materials, including gas and rock phosphate. Currently all fertilizer must be imported, from South Africa, Zimbabwe, or elsewhere, and any private trader can arrange for the import license, but with a delay of up to 4 months. Currently fertilizer imports are less than 10,000 metric tons per year. The cotton, tea, citrus, and sugar cane companies are the major importers of agrochemicals, using both commercial imports and the KRII program of imported inputs, to be discussed more below. Commercial agrochemical imports are generally conducted for the large cash-cropping firms (LOMACO and others) and not for unsolicited commercial sales, as there are few retail input dealers in the country outside Maputo. KRII imports are used to satisfy smallholder demand.

Since 1996, the Japanese government has funded the KRII program KRII, an aid program in which the Mozambican government identifies about $9 million worth of chemical inputs and machinery from a list supplied by the Japanese government. The Japanese Government then pays for the delivery. This is about 50% of the input needs for the country, so it is significant on the Mozambican market. Once the Mozambican government chooses what they would like imported, the Mozambican parastatal INTERQUIMICA issues the tenders for Japanese firms (later opened to some OECD firms). According to the agreement, counterpart funds are paid in by the Mozambican private sector upon receipt of the inputs and machinery, although the Mozambican firms have very favorable terms. The funds are supposed to be deposited with MADER for development funds, but little known is about this and there is no public accounting. Prices to the private sector are generally below world prices for those products, but since retail prices are unregulated for fertilizers and pesticides, it is not clear that the small farmers see a lower price than commercial imports would have. Recently the private sector has indicated less interest in the KRII products stating reasons of cost, inadequate quality, delays in receipt of supplies, and bureaucratic problems in getting the supplies released from customs. Recent legislative scandals in Japan and questions raised about the effectiveness of the KRII program have left the program in controversy and its future is in doubt, particularly for the chemical input supplies. There are currently stocks in the country, in unknown condition in storage, and those will be distributed in the coming year.

Seeds are both imported and produced locally. As stated by Howard et al. (2001) “The seed supply system can be conceptualized as a continuum of seed organizations ranging from formal large-scale multinational seed corporations to parastatal seed companies, NGO-supported seed networks, informal farmer seed exchanges and farmer-retained seed” (page 11). Among the actors in Mozambique are SEMOC (now SeedCo), PANNAR, INIA, UEM, many NGOS including CARE, World Vision, and Food for the Hungry International (FHI), as well as farmer associations. SEMOC was formerly the semi-commercial firm responsible for seed multiplication and sales throughout the country. Formed in 1989, it was a joint venture with Swedish government and private sector funding, as well as Mozambican government. It produced seeds for maize, rice, groundnut, beans, sorghum, sunflower, cowpeas, soybean and some vegetables, working in collaboration with National Agricultural Research Institute (INIA) and the University of Eduardo Mondlane (UEM). Figure 2.11 shows the trends in SEMOC sales; the high post-war peaks are discussed below. In 1998, SeedCo, a Zimbabwean firm, purchased

the majority ownership of SEMOC, who have been working to establish more retail outlets and demand for seed. They are working with NGO programs for seed multiplication to increase local supplies, but there continue to be problems, as noted by Howard et al (2001). A relatively new entrant is Pannar-Mozambique, affiliated with Pannar South Africa, which has sold imported seeds and is developing local supplies for some seeds, as well. There are other international seed companies entering through registered commercial agents, for sales of imported seeds.

These commercial sector developments come after major public sector activities in seed supplies. Right after the Peace Accords were signed and following the years of drought, NGOs and government distributed substantial amounts of seeds for basic consumption goods under the Emergency Program for Seeds and Implements ("Programa de Emergência para Sementes e Utensílios" known as PESU), so many farmers started with new stocks then. Now, however, farmers receive new stocks only in selected areas after a major disaster, such as large areas affected by the floods in 2000 and other areas affected by drought in 2001/2002. There was emergency distribution of millet, sorghum, maize, sunflowers, and other crops in lesser quantities due to a combination of problems. After the floods in 2000, seeds and planting materials were distributed in the affected regions. Otherwise, farmers use nonmarket sources, either their own or supplies from their neighbors. Cottonseed is an exception and is usually made available through outgrower schemes or otherwise through the cotton companies. The 1996 TIA data show these trends (Figure 2.12 A-K), demonstrating that only cottonseed is generally obtained through market channels. For most crops, 63-82% of seeds are obtained either through own saved seeds or through neighbors, with the exception of cotton (only 18% from those sources) and cassava (92% from those sources). In 2002/2003, there are efforts at distributing planting materials for cassava and sweet potatoes through aid or other sources (emergency and NGO distributions, extension service) due to INIA and extension efforts to address disease problems in cassava and to encourage yellow-pulped sweet potato for vitamin A benefits.

2. Trends in utilization

With only 3% of farmers using fertilizers and 4.5% using pesticides, utilization of chemical inputs is very limited in Mozambique. In the 1980s, with the state farm sector operating, fertilizer consumption was 40-60,000 metric tons per year, but with the privatization of the state farm sector, current use is closer to 10,000 metric tons. There are signs that peri-urban use of fertilizers is increasing for use on high value crops for urban sales (Vlassios 1997, cited by Howard, Soares and Low, 2000). Pesticide use in 1994/95 reached almost 1 million liters/kilos and declined to 820000 liters/kilos by 1998/99 (more recent statistics are not available), and pesticides are mostly used for cotton, citrus and sugarcane.

For seeds, SEMOC sales based on imports and domestic production at SEMOC farms were high, reaching 14,000 metric tons sold in 1994 and 1995; however much of this growth was based on emergency distributions, especially PESU. Since then, SEMOC sales have remained around 3000 metric tons per year (Howard et al., 2001). New entrants such as PANNAR and Tecap contribute a relatively small amount of imported seed and are increasing their links with farmers associations or large-scale farmers to produce more locally.

3. Industry overview

For fertilizers, the idea of rehabilitating the Matola facilities to create just mixing capacity has been raised, but as yet, no actions have been taken. Thus there really is no fertilizer or pesticide industry in Mozambique. As discussed above, the commercial sector imports either privately based on contracts with large-scale producers or processors, or it uses fertilizers and pesticides from the KRII program.

Only in seeds can you talk about an existing industry and it is a combination of private, public and NGO efforts to establish the seed supplies necessary in the country and then develop commercial outlets for them. SEMOC capacity for cleaning and preparing seeds includes five facilities in the country (Howard et al., 2001).

4. Policy overview

The inputs sector is liberalized in Mozambique, with growing private sector participation and investment. The main agricultural sector users, however, are the large commercial concerns with financial power and quantity demands to make import or domestic production profitable for the private sector, in the short run. The extremely low level of use of inputs and improved seeds, though, is seen as a challenge that requires public sector involvement in more than just regulations. Growth in productivity through purchased inputs will continue to be constrained in the future due to a lack of rural traders to deal with inputs, lack of extension agents to work with farmers on productivity, lack of credit for input purchases, high transaction costs for inputs such that prices are high with low volumes, and unreliable product markets to lower the risks of using inputs (MADER, 2001a).

Current policy stresses the role of the private sector in input provision, while recognizing that the public sector can assist in developing markets, lowering transaction costs and training farmers on input use. Contract farming is seen as one of the ways to improve coordination and is encouraged by the government. Farmers associations are seen as a way to reduce costs of coordination and improve the access and use of inputs by smallholders, particularly the poorest farmers (MADER, 2001a). Government investment in roads and other infrastructure are another key component in improving smallholder participation in growth. A recently developed Seed Sector Strategy emphasizes the development of local production capacity, both in the formal seed sector as well as at community levels. The key actions within that strategy include the following:

- Facilitate private sector production and marketing of seeds, particularly in rural zones;
- Promote local seed production;
- Increase the quality and quantity of breeder and foundation seeds
- Implement regional agreements to harmonize seed policies in the neighboring countries
- Establish a system to monitor improved seeds and evaluate different methods for distributing seeds during emergencies (MADER, 2001a)

There are other public policy actions related to improved technologies, including an emphasis on demonstration plots for varieties and inputs, targeted programs for diseases and pests such as brown streak in cassava and powdery mildew in cashew, as well as outsourcing programs with extension. The National Directorate for Rural Extension (DNER) is working with SG2000 on the development of demand for technology enhancements, including QPM. MIC is involved in

efforts to simplify trade and other regulations such that bureaucratic red tape can be minimized, facilitating the imports of inputs. The promotion of rural traders (both formal and informal), with training and credit programs for supplies, is seen as a way to improve small farmer access to inputs through the private sector, while increasing the private sector effectiveness in dealing with inputs. The market information system SIMA with MADER will be including inputs in their system to inform on pricing and availability, but this work is just beginning. These aspects will be addressed below.

3. Policies and Institutions

a. Role and funding of agriculture within PARPA and UNDAF

The Mozambican government with its partners developed the interim Action Plan for Poverty Reduction of 2000-2004 focused on short-term measures to ameliorate immediate food insecurity. The first full PARPA for 2001-2005 (Mozambique, Government of, 2001) focuses on growth to help eliminate the problem of food insecurity. With nearly 70% of the population living below the poverty line and most of them in rural areas, dependent on the agricultural sector for consumption and income, one of the fundamental areas of action in the PARPA is agricultural growth and rural development.

When looking at overall public expenditures in the priority areas for PARPA, agriculture ranks fifth for total spending with 6% of spending over the 2001-2005 period, behind education (32%), health (19%), infrastructures (29%), and good governance (12%) (Mozambique, Government of, 2001). Investments in infrastructure (particularly roads), education, and governance structures will help with agricultural growth, so the total effect on agriculture should be higher than just the direct investments would imply. As will be discussed further below, a common pool funding mechanism was developed called PROAGRI in which almost all funds for agriculture from foreign assistance are put under the direction of MADER to allocate to agreed priorities. PARPA funding specifically for agriculture comes from those pooled funds. To allocate the funding, PARPA envisions two main pillars in agriculture: "1) empowering the producers to increase the productivity of their activities; and 2) transforming the role of public institutions, to facilitate and support producers through the provision of essential services, to ensure growth of the sector and reduce absolute poverty in the family sector" (Mozambique, Government of, 2001, parag.156). There are four key strategic objectives of PROAGRI that provide for poverty reduction:

1) Raise the productive capacity and productivity of agriculture, forestry and animal husbandry in the family sector and the private sector using labor-intensive technologies, and sustainable management of natural resources.
2) Guarantee the rights of access to land and reduce the bureaucracy associated with land registration.
3) Promote the marketing of agricultural and livestock products, and facilitate the marketing of surpluses and access to markets (for factors of production as well as credit).
4) Reduce the vulnerability of households and chronic food insecurity.

For the latter objective, there is a special unit within MADER, the Technical Secretariat for Food Security and Nutrition (SETSAN), designed to provide the multisectoral linkages between MADER and other agencies and institutions at national and provincial levels, to highlight programs that can reduce the vulnerability to chronic food insecurity. The Food and Nutritional

Security Strategy was developed in 1998 and forms the basis for the work of SETSAN, as well as overall government strategies (Mozambique, Government of, 1998). There are strategies to improve the availability of food, including increasing agricultural productivity and fishing as well as import capacity when needed, and export when there is an advantage for the country. There are strategies to improve household access to food, including road development, information systems, and investments in trade. Finally there are strategies to improve the utilization of food, including nutrition education, disease prevention and treatment, and prevention of malnutrition. The strategy did not include the establishment of food reserves at a national level, although it entered the debate. Market-based approaches and public service intervention with core services are the focus of this overall strategy.

Within the United Nations Development Assistance Framework (UNDAF) 2002-2006 for Mozambique (United Nations, 2001), using a "rights-based approach" there will be major commitments of funding to HIV/AIDS (the number 1 priority) and gender equity (particularly for education). In Mozambique, the following UN agencies have resident programs: UNDP, UNFPA, UNICEF, and WFP, with FAO, UNESCO and WHO also having resident missions.

A Common Country Assessment completed in 2001 by a UN team along with government, other donors, and non-governmental partners developed the strategic objectives and recommendations for UN funding across the UN agencies. These recommendations are meant to orient UN agency activities and investments, based on their comparative advantage. Under UNDAF, the agencies will mobilize resources for some programming, coordinate assistance in some areas, provide technical expertise in areas of specialization, and assist with developing strategic and long-term plans.

Strategic objective 3 (SO3) of the UNDAF is "to promote the fulfillment of the right to sustainable livelihoods" including rural development and agriculture programs as well as employment, markets, and private sector development. With resources of about US $10 million for the UN agencies and another US$26 million for the specialized agencies, activities for SO3 will be developed. This is about 10% of total estimated resources for the UN in Mozambique during the four-year period. The UN team identified a range of recommendations associated with SO3, including the following (not an exhaustive listing), many of which are found within PROAGRI as well:

For rural development and agriculture

- Decentralized administration support for strengthening and streamlining public service delivery at local levels and supporting multi-disciplinary and 'multi-partner' approach
- Participation of rural populations in decision-making
- Revision and simplification of registration procedures for farmer associations
- Measurable impact of PROAGRI on agricultural productivity
- Diversification of market-orientated production, and rural incomes to encourage a demand driven response for the growth in rural service delivery

For Food Security

- Increasing commercial and market linkages for food surplus regions in the north and food-deficit areas of the south
- Increase role of women in food production, food access and preparation. Girls' and community education are key to longer term improvements in care and nutrition
- Improved technologies
- A clear and implemented land tenure policy to ensure household security

For employment, the private sector, and markets

- Strengthening national capacity to channel available financial resources to the private sector, particularly in the provinces
- Lowering cost of credit and improving conditions for investment and business development in the provinces, especially supporting agro-industry
- Improving the legal framework for the formalization of micro and small scale business
- Strengthening the technical capacity of the labor force, including improving the coordination between education and vocation training system and the needs of the labor market (United Nations, 2001).

Clearly, both UNDAF and PARPA see agricultural growth and rural development as keys to helping reduce poverty in Mozambique, and PROAGRI is designed to ensure the institutional basis in MADER for achieving growth in the agricultural sector. The funds indicated for UNDAF and PARPA that are specifically in the agricultural sector are included in the overall expenditure estimates for MADER under PROAGRI. Funds designated for activities outside MADER (such as financial resources for the private sector and land tenure issue) are not included in PROAGRI.[16]

The Mozambican government is still highly dependent on donor funding for much of its budget, in spite of rapid GDP growth since the Peace Accords. For example in 1997, of the $48 million of public expenditure by MAP (now MADER), only US$ 5 million came from the Government, the rest from donors, in at least 42 different projects. Through 1997, the macroeconomic and agricultural sector reform programs had created a growth environment, but institutional reform was still needed and so PROAGRI was developed. By combining donor funding into a single funding mechanism, the main idea is to limit MADER to core activities, improve efficiency and capacity at national and provincial levels, and leave other activities to the private sector or other agencies (including rural credit and rural road infrastructure). The design of PROAGRI was a consultative process with MADER staff, and representatives from the donors, from international financial institutions, from NGOs and from other sectors. Now, instead of responding to 42 different projects/donors, MADER can consolidate its reporting and design an institutional strategy.

There are eight components to PROAGRI, based on the main functional units of MADER, and the initial funding over a five year period 1999-2003 was estimated at US $202 million, using US$ 30 million in funds from World Bank and the rest from participating donors. Of that amount, US $26 million was for agricultural research, US $26 million for agricultural extension,

[16] A recent PROAGRI evaluation written by an FAO/UN combined team was highly critical of PROAGRI and not well-received in Mozambique. For its critiques and more information about current PROAGRI programming, see the PROAGRI website http://www.pwg.gov.mz

US $20 million to livestock development, US $4 million to support crop production, while another US $71 million was to be allocated across the three natural resource themes: forestry and wildlife, land management and small scale irrigation (World Bank, 1998). Conceived as a 15-20 year commitment to funding, continuation of World Bank participation after the first five years is contingent on the institutional reform and improved provincial level managerial capacity of MADER, as well as donor commitment and provision of counterpart funds. PROAGRI documents, combined with the PARPA, provide the vision of how the Mozambican government hopes to reduce poverty and achieve sustainable and equitable economic growth.

b. National agriculture/rural development policy framework

PARPA provides the programmatic approach to poverty alleviation through rural development efforts, because so many of Mozambican poor are in rural areas. As mentioned earlier, analysis of the 1997 National Household Survey (known as IAF) identified six major determinants of poverty, providing a focus for PARPA objectives and activities. The interim PARPA addressed the immediate needs of the most vulnerable, but this PARPA focuses on the underlying causes, with major efforts to improve core rural services (education, extension, transport) while facilitating investments in the private sector to provide income earning opportunities. Multisectoral approaches are designed to ameliorate vulnerabilities while encouraging growth. PROAGRI documents provide the insight into government strategies to develop agriculture through core public sector services of MADER while working in public/private partnerships to provide additional services such as credit, market infrastructure, and roads.

The initial five-year period of PROAGRI is based on four priorities:

- Strengthen government institutions, to be able to formulate and advocate enabling policies for small holder and private sector development in agricultural sector;
- Strengthen the managerial capabilities of Ministry of Agriculture and Fisheries, (now MADER) providing transparent and sound management practices;
- Support public service delivery to the communities such as research, extension, livestock health, etc.; and finally
- Support natural resources sustainable management through provision of good practices in forest and wildlife management and land management (World Bank, 1998).

With the institutional reform process, decentralization of MADER (as with other ministries eventually) means that provincial and district level resources will be managed at those levels. Already the Annual Action Plans and Budgets (PAAOs) are elaborated at the provincial level, evaluated and revised with the central level, and then disbursements are based on them. Other Ministries are also looking at decentralization as a way to gain accountability and have more real gains outside the capital city.

However, institutional reform of MADER is only the short-term objective, needed to ensure that the government can effectively provide the technological development and support that farmers need to improve productivity and diversify Mozambican agriculture. MADER leadership focuses on decentralization to ensure accountability of MADER to the people in rural areas. Markets, particularly export markets, are to provide the incentives for productivity enhancements, while research and the private sector help provide the technology solutions. Agro-processing in rural areas will enhance the value added for those areas, resulting in higher incomes. For the most vulnerable populations, investments in basic food crops and public sector

extension activities will improve the nutritional benefits from crops such as quality protein maize, orange-fleshed sweet potatoes and cassava, and identify diversification crops for diets and for market sales and income. Livestock and fisheries are to be examined for possible alternative sources where agricultural potential is limited. In all cases, the environmental impacts are to be assessed by MADER prior to action, for MADER is responsible for ensuring natural resource quality.

c. National priorities and development targets

The proposal letter for PROAGRI from the Minister of Finance and Planning states the 6 priority policies for agriculture in the coming years:

1) Continue to develop an enabling environment for market-based agricultural development;
2) Improve road transport and communications infrastructure;
3) Redress the lack of appropriate technologies available for smallholder farmers;
4) Regulate agricultural markets and natural resource use to establish the "rules of the game" and ensure that negative and positive externalities are internalized;
5) Continuation of stable macroeconomic policy and measures to institutionalize "good governance" throughout the public sector;
6) Establish a policy framework for micro/rural finance that will guide any public support for formal and informal intermediation between the commercial banks and the urban and rural poor (written in1999, as found in Annex 11 of World Bank, 1999).

Given these priorities for PROAGRI, the Mozambican government established a set of priorities for agricultural growth and rural development. These are summarized in a document prepared by the National Directorate for Agriculture (DINA) for the 2002 World Food Summit:

> The main strategy of PROAGRI and the policies that support the program is the development of agrarian activity based on the family sector. It is intended to promote an agrarian sector, which responds to the evolution of the market and to use resources in an efficient and sustainable way. Based on this PROAGRI will create the institutional capacity to:
>
> - Continue the development of market reforms that will articulate with the new intersectoral strategies;
> - Deregulate the agriculture sector and reduce the direct involvement of the state in the production, price setting, processing and commercialisation of agricultural products ;
> - Introduce reforms on land utilization and sustainable improvements for the use of natural resources;
> - Diversify and expand the family agricultural sector, reorientation food production, commercial crops production, extensive cattle and wildlife production and reforestation;
> - Reorient the agricultural production support services in order to respond to the comparative advantages of each agro ecological region in the provision of services; and

- Develop and expand the small-scale irrigation (Ministry of Agricultural and Rural Development (MADER), 2002).[17]

There are several priorities that are multisectoral and require coordination between institutions. Market development is one example. The recent Agricultural Marketing Strategy (Conselho de Ministros, 2001), written primarily by staff at the Ministry of Commerce, proposes focusing on market infrastructure as well as market information and trade facilitation through reduced transaction costs and enhanced government incentives for trade. Periodic rural markets, or "ferias", are included in the Strategy as a way to increase the presence of informal traders and producers in markets and lower costs of coordination between them. Based on experience in other countries and increasing experience in Zambezia and elsewhere in Mozambique, this strategy looks to encourage the development of informal but regular markets, along with other market alternatives (established regular markets, rural stores, etc.). A recent DNC/MIC report (2001) stresses the functionality of the periodic markets in Mozambique and proposes a way forward to understand further and promote such markets.

Agricultural extension is one of the key components of PROAGRI and an Extension Master Plan was developed to guide the process of improving the extension system. As described by one observer, the Extension Master Plan engenders a combination of public, NGO and private extension agents who respond to the demand pressure for technologies and training from strong farmer and producer associations (Eicher, 2002).

For research, PROAGRI envisions the creation of the Agricultural Research Council to coordinate across the four main agricultural and livestock research institutions in the country. In the long run, consolidating the research centers into a single entity is being considered. The lack of personnel and inadequate resources for research are seen as areas for which the ARC can negotiate and develop budget criteria in a coherent fashion.

There are specific targets in the PARPA 2001-2005, reaching to 2010 for some aspects. Overall, the population living in poverty should decline to 60% by 2005 and then reduce further to 50% by 2010 (Mozambique, Government of, 2001). The PARPA states clear targets for MADER work under its framework for the five-year period ending in 2005. Agricultural growth should increase from the current 7.3% to 8% by 2005. About 460,000 producers in the family sector will have adopted improved techniques and 2,500 hectares will be added to land under small-scale irrigation. The production of cereals will grow from 1.471 millions tons in 1999/2000 to 1.725 million tons in 2003/2004. The only other crop specifically mentioned in the PARPA targets was cashew nuts, where production should grow from 50,000 tons to 100,000. There is no target specified for SETSAN, but reduction in the number of districts suffering from food insecurity should occur (in 2000, 38 out of 144 districts were considered to have food insecurity) (Mozambique, Government of, 2001).

1. Regional

In the PARPA there are priority geographical areas, based on agricultural potential and populations in poverty: the interior of Maputo Province; the south of Gaza; the coastal areas south of the Save River; the medium altitude areas of Zambezia, Nampula and Tete; the south of Cabo Delgado and Niassa; and the coast of Zambezia, Nampula and Cabo Delgado

[17] More detailed information can be found in Attachments 1 and 2 of the World Bank Project Appraisal document, (World Bank, 1999).

(Mozambique, Government of, 2001, paragraph 167.1). PROAGRI, however, is based on the idea of decentralization and does not propose regional targets for the country. Each province should set its own targets through a participative process and then submit these with their budget requests (MADER, 2002). The targets will vary by agroecological region, recognizing the agricultural potential, as well as other options. In the draft 2003 PAAOs currently under consideration, over 60% of the total budget is proposed for institutional reform in the provinces. In some provinces, the amount proposed is higher, with Zambezia budgeting 79% of the budget to institutional reform, and 15% for production services and 6% for natural resource work. The budgeting line for institutional reform includes training at provincial and district levels, in addition to other aspects, and it is clearly seen as a priority in the next few years. Within the provinces, specific agricultural and livestock activities across extension and research capture the funds under production services.

2. Commodity

The research priorities for the PARPA are the following basic crops: maize, cassava, beans, rice, cashews, and cotton (Mozambique, Government of, 2001). The inclusion of cash crops follows the PARPA and PROAGRI strategy of increasing incomes for the rural poor. Even research on the food crops involves increasing the market potential as well as efficiency in crop production to increase quality and availability in the home, but also for the market.

d. National Research System

1. Organizational Structure

The development of formal agricultural research in Mozambique began in 1940 with surveys on natural resources, botany and veterinary studies, followed by the introduction of research activities that were more oriented for commercial farming. However, the real emergence of agricultural research system in Mozambique only occurred in 1965 and 1966 when the Mozambican Institute for Agronomic Research (IIAM) and the Mozambican Institute for Veterinary Research (IIVM), respectively, were formally institutionalized as two autonomous bodies. The mandate of IIAM was to carry out research on crop improvement, animal husbandry and forestry, while the scope of work of IIVM was for research on animal pests and diseases and artificial insemination. In order to develop its mandate, IIAM was organized in three regional centers across the country, each of which covered a particular geographical area and each center had a basic network of several experimental units spread within the provinces. The headquarters was located in the capital where there were central laboratories for soils, plant pathology, entomology, food chemistry and cereals. During this stage, which lasted until independence of the country in 1975, the emphasis of the agricultural research agenda was mainly based on the needs of commercial farmers who could afford to purchase improved agricultural inputs and develop specific crops oriented to the market. This period was marked by important contributions in the development of agricultural science and technology in Mozambique, including studies on soils, climate and vegetation and also the release of varieties of important crops.

With the advent of independence, IIAM and IIVM were both integrated as departments under the Ministry of Agriculture. IIAM was then renamed as National Institute for Agronomic Research (INIA) under the National Directorate of Agriculture (DINA) and IIVM changed to the National Institute for Veterinary Research (INIVE) under the auspices of the National

Directorate of Livestock (DINAP). Further, in 1981 the Centre for Artificial Insemination (CEFRIA) became an independent body from INIVE and later transformed to the Institute for Animal Production (IPA) with its mandate extended to conduct research on animal nutrition and breeding. Likewise, in 1985 the mandate for forestry research was displaced from INIA and attributed to the National Directorate of Forestry and Wildlife, which then established the Center for Forestry Experimentation and Wildlife Management (CEF). During 1987 and 1988, the three public research institutes, namely INIA, INIVE and IPA were legally recognized as entities with administrative and financial autonomy under the auspices of the Ministry of Agriculture, but CEF still remains legally attached to its counterpart directorate within MADER. These four research institutions under the Ministry of Agriculture and Rural Development (MADER), namely INIA, INIVE, IPA and CEF, presently constitute the core network of the agricultural research system within the country.

These institutes each have a headquarters in Maputo (where resources, especially scientists and scientific equipment, are currently concentrated) and a network of research stations and sub-stations located at provincial level (Figure 1.4). Many of the research stations and substations outside Maputo have received little support from the center and have been largely sustained by the provincial agricultural directorates or non-governmental organizations. However, definite steps have been taken toward decentralization of resources from Maputo.

Apart from the aforementioned institutions, other organizations are also engaged in the development of agricultural research. They comprise institutions of higher education, NGOs and private sector, most of which have already established formal or informal links and partnership with the research network under MADER. Linkages between NGOs and private sector and government research bodies vary widely and there is generally little institutionalized coordination of their agricultural research activities.

There are several institutions of higher education within the country, although most have only recently emerged and only a few are teaching agricultural courses. The exception is Eduardo Mondlane University (UEM) that existed before Independence, and of all the educational institutions currently carries out the most agricultural research. A formal Memorandum of Understanding has been signed between MADER and UEM to facilitate linkages in relation to agricultural research. The Faculty of Agronomy in Cuamba under the Catholic University of Mozambique is also taking steps to consolidate its current research activities and its location within a rural area is viewed as being a comparative advantage for promoting a strong linkage with rural communities.

A number of NGOs are actively involved in agricultural development programs in Mozambique, including Africare, World Vision (WV), Care International, Adventist Development and Relief Agency International (ADRA), Food for the Hungry International (FHI), Save the Children and Lutheran Foundation. By and large, overall interventions of NGOs aim at increasing food security and nutrition, farmer's income and poverty reduction. Most of these interventions are developed with the involvement of farmers in the rural communities and in general, research activities are carried out to support their agricultural development programs (for examples, see Mairoce et al. 2002, CARE, 2002 and Africare 2002). The majority of research activities developed by NGOs comprise the establishment of participatory adaptive trials, seed multiplication and demonstration plots, especially for basic food crops, such as maize, sorghum, rice, horticultural crops and grain legumes. There are, however, a few exceptions, such as ADRA, which is currently involved in research in the commercial crop cashew, in contrast to

World Vision (WV) that recently disengaged itself not only from research of this crop but also from running, or establishing, new research sites on any crops at the request of their donors.

The private sector is mostly characterized by large companies growing or contracting small farmers to produce cash crops such as cotton, cashew, citrus, tea, tobacco and sugar cane. While in the past most of these companies used to be involved in financing (especially through levies in cotton and cashew) and/or the implementation of adaptive agriculture research, their intervention in this area of work is now very limited and confined to fewer crops, particularly with the financial support of the European Union in cotton and cashew.
There are also private seed companies operating in Mozambique, of whom SEMOC/SEEDCO and PANNAR are the largest. These two companies have engaged in research to develop new crop varieties. SEMOC conducted a large research program in the past and has continued on a smaller scale since joining forces with SEEDCO. The larger part of the research of this company is now conducted in Zimbabwe and many crops have been dropped from the program such as rice and cowpea. The products of research have been commercially traded between SEMOC and government research bodies for many years but there has also been a limited non-financial collaboration between the two entities. PANNAR largely undertakes research outside of Mozambique but has depended on Mozambican organizations to test their material in local conditions.

2. Research Network under MADER

The goals of the MADER Research Network were developed in the policy environment of the government's PARPA and its agricultural policy, which is implemented through the Sector Investment Program, PROAGRI, as discussed above. In this context the overall role of public agricultural research under MADER is to generate, make available and promote knowledge and information on crops, forestry and livestock for producers with the aim to increase sustainable agricultural production and productivity for small-scale holders and commercial farmers, and taking into account differences in agro-ecological and socio-economic conditions. To achieve these goals, agricultural research is mainly engaged in a combination of applied, adaptive and on farm activities. The strategy of agricultural research also emphasizes the need for a greater participation of stakeholders and also the integration of social, economic and gender issues in the agricultural research agenda.

Although the four research institutions under MADER follow a similar overall objective they fulfill distinct functions and activities to comply with their own specific mandates.

I) National Institute for Agronomic Research (INIA)

The mission of INIA is to contribute towards increased agricultural production and productivity through technological development, dissemination and sustainable management of natural resources. The institute is organized around three technical departments and one administrative and financial department. Each department carries out a set of different activities. The technical departments are as follows:

II) Department of Agriculture and Farming System (DASP)

The main areas of research are:

- Crop improvement of several food (maize, sorghum, millet, rice, cassava, sweet potato, grain legumes) and cash crops (cotton and cashew nut).
- Farming system research

- Integrated pest management
- Post harvesting and Agro-processing research

III) Department of Land and Water (DTA)

The main areas of research are:

- Soil fertility evaluation
- Agro-hydrology, particularly for crop water requirements, water use efficiency and water management
- Soil survey and land evaluation, involving soil resources inventory, land suitability classification, soil management, soil and climatic data base development

IV) Department of Botany

The main areas of intervention are:

- Conservation and sustainable use of plant genetic resources, involving characterization and mapping of plant genetic resources
- Studies on edible, medicinal and ornamental wild plants.

V) National Institute for Veterinary Research (INIVE)

The mission of INIVE is:

To undertake multidisciplinary studies in the area of veterinary research and technology in co-ordination with other organizations and institutions and to provide specialized services to assist in the prevention of major diseases causing morbidity and mortality that hamper livestock production.

The main areas of research, studies and services are:

- Diagnosis of animal diseases (bacterial, viral, parasites, protozoa, etc.)
- Research on epidemiological parameters of animal diseases and on factors limiting livestock production in Mozambique
- Control of food hygiene and food borne diseases
- Diagnosis and control of zoonoses (rabies, tuberculosis, brucellosis, etc)
- Control of biological products and drugs
- Development and production of vaccines
- Production and development of biological products (antigens, immunoglobulins, sera)

VI) Institute for Animal Production (IPA)

The mission of IPA is to develop technologies that contribute towards an increased agricultural production and productivity of different farming systems, which guarantee both, the sustainability in the use of natural resource and social equity.

The main areas of research are:

Nutrition and availability of food resources (natural pastures, forages and by-products)

- Reproduction and artificial insemination
- Improvement and selection of cattle, small ruminants and pigs, with emphasis on landraces and their crosses
- Livestock farming system with emphasis on small-scale producers

VII) Center for Forest Experimentation and Wildlife Management (CEF)

The mission of this center is to develop research and provide services concerning forest and wildlife that preserves and promotes the sustainable use of these resources and that increases their productivity and improves the welfare of the population.

The main areas of research, studies and services are:

- Ecology and management
- Economy and Communities
- Agro-forestry
- Forest Products
- Human resources

3. Human resources

Throughout the agricultural research system, the human resource base constitutes one of the most important factors that constrain the management, implementation and development of the agricultural research network of MADER and is likely to remain so, unless important steps are taken to promote training, retention and expansion of the existing numbers of qualified researchers. This limitation is not only in terms of the inadequate numbers of qualified researchers available within the system but also due to the lack of scientific staff to cover important areas or domains of research, such as biotechnology and crop improvement, plant protection, food technology, economic, social sciences and other areas, including post harvest issues. These restrictions combined with inadequate financial and research facilities seriously limit the amount, type, effectiveness and the ability of public institutions to conduct agricultural research that addresses the major production constraints and that is responsive to the objectives of agricultural development. As a result, there is a limited impact of agricultural research on reduction in poverty, increased food security and yields and also to increased productivity of labor and a maintained, and improved, natural resource basis.

This situation could be partly attributed to the low emphasis given to building the capacity of the research institutions due to other developmental priorities during the early stages of the country's independence. The problem has been exacerbated by the devastating and prolonged civil war. There was also, for many years, a lack of strategic planning that would identify the gaps, needs and define an implementation plan and monitoring and evaluation tools for human resource development. In fact, it was not until the mid 80s that the first and sole master plan of the public research system was developed for INIA in collaboration with ISNAR, which had a focus on human resource development. However, due to funding constraints, this master plan was never fully implemented and has had very little impact on training and development of human resource basis.

The problem is compounded by the generally poor conditions of employment and the low level of incentive that still prevails within the public research system, resulting in a relative high turnover of highly qualified scientists, particularly due to competition from the private sector, NGOs and other organizations. For the same reason the remaining highly-qualified staff are also only partially involved in research activities since they are forced to complement their salaries with other activities which are not necessarily related with the agenda of the research institutions. These constraints combined with poor research infrastructure and degraded equipment are particularly exacerbated in the experimental units in the provinces. These combined restrictions are the core reasons for the higher concentration of research staff in the

headquarters as compared to the staff in the experimental stations. The impact of this higher concentration of staff in the headquarters is expressed in low cost effectiveness and in the relatively high cost of conducting research due to the expenditures associated with supervision missions.

The whole research network of MADER comprises a total of 1,194 employees (Table 3.1) but only around 10% of the overall staff holds a university degree, of which a limited number have been trained to PhD and MSc levels. Thus, a substantial part of agricultural research still relies on staff with an undergraduate level qualification. It must be emphasized that the total of 111 holders of University degree in the Table do not reflect the number of researchers that are presently available since a significant number (around 10) have been seconded while others are currently undergoing higher education training (around 20), particularly from INIA that recently sent staff abroad for MSc (9) and PhD (2) courses. It is clear from this scenario that there are insufficient numbers of qualified staff to carry out agricultural research. Thus, the ability of the public research institutes to fulfill their mandates is limited. Table 3.1 also shows that there is a great concentration of staff at the headquarters of the research institutions, a fact that limits the implementation of priority research across different agro-ecological regions that exist within the country.

Table 3.1 Staff available within the public research system of MADER

Degree	Total Staff					
	Male	Female	**Total**	Headquarters	Experimental Stations	% in the Headquarters
PhD	4	2	6	6	-	100
MSc	14	12	26	24	2	92
BSc	56	23	79	55	24	70
Sub-total	74	37	111	85	26	75
Diploma	64	52	116	92	24	79
Certificate	241	16	257	179	78	70
Sub-total	305	68	373	271	102	73
Support staff	533	177	710	586	124	83
Overall	912	282	1,194	942	247	79

Source: KIT (2000): Institutional Reforms of the Agricultural Research System under MADER

Table 3.2 shows areas of research and activities in which the scientific staff are currently engaged. Studies made by KIT (2000) indicate that most of the researchers are involved in the area of plant sciences (38%), while there are not noticeable differences between the number of scientific staff engaged in the research field of natural resources (29%) and animal science (28%). It must be noted that the activities listed in Table 3.2 correspond, by and large, to the current mandates of the research institutions/departments. However, most of these activities are not taking place for previously mentioned reasons. In addition, it can be seen from Table 3.2 that there are important and relevant areas of research that are not yet being covered, particularly in the field of socio-economic studies. Nevertheless, with the goal of institutionalizing a farming system perspective of agricultural research, a team of farming system researchers (from all institutions) was set up at the national and at the provincial level where relevant staff from technical departments of the provincial directorate of agriculture are also involved. However, the influence of these teams in re-orienting the research agenda has not yet reached fruition.

Table 3.3 illustrates that INIA is the research institution of MADER that employs the majority of staff and holds most of the scientific staff including those holding a post-graduate degree. This situation is in part due to the fact that INIA owns the majority of the experimental network that exists in the country, and research on crops has always received greater financial support, particularly from donors (including the World Bank) when compared to other agricultural areas of research under MADER.

Table 3.2 Areas of Research and Activities for each Research Institution under MADER

Area of Research	Research Institution	Current Activities
Plant Science	INIA (DASP)	Crop improvement, including plant breeding (maize and cassava) and mainly plant selection of cereals (maize, rice, sorghum & millet), root & tubers (cassava and sweet potato), grain legumes (cowpea, beans, pigeon pea & groundnut); cash crops (cotton and cashew) and fruit & horticulture crops; Plant protection with emphasis on IPM, entomological & phytopatological studies, crop protection studies; Agronomy; Farming system analysis; Germplasm conservation and Seed multiplication.
Natural Resource	INIA (DTA)	Soil fertility & water management (irrigated & rainfed) & Conservation, Soil and Water inventories; Land evaluation for land use planning; Systematic soil mapping; Land resources information system using computer-based GIS, Climate data base and Soil Laboratory service.
	INIA (Botany)	Plant Genetic resource- National gene bank (germplasm survey, collection, characterization, regeneration & in & ex-situ conservation); Taxonomic studies; Vegetation mapping; Protected plant list elaboration; Herbarium maintenance and research on edible, medicinal & ornamental wild plants
	CEF	Forestry (test and evaluation and multiplication technology for seed production of exotic and endemic tree plants; tree crop breeding and seed production agro-forestry research); Ecology and management (Forestry regeneration and dynamics, commercial tree growth rate, biodiversity & conservation); Forestry products (forestry exploitation & processing, forestry product diversification); Communities and economics (community based natural resource management, integrated management systems, timber and other forestry product diversification).
Animal Production	INIVE	Diagnostic studies (animal diseases diagnostics - parasitic, bacterial and viral diseases, mortality & morbidity studies, laboratory services); Evaluation and production of biological products (particularly thermo-stable vaccines for Newcastle disease); Food quality control; Animal drugs control.
	IPA	Management and farming system; Animal nutrition and supplementary feeding; Animal reproduction (reproduction control in milk and beef cattle, artificial insemination – cattle, goats, sheep & pigs); Animal breeding (cattle, goats, sheep & pigs, productivity analysis, pedigree registration)

Table 3.3 Distribution of staff across public research institutions and locations

Institute	Site Positioned	Holders of University Degree				Non Holders of University Degree		
		PhD	MSc	BSc	Total	Diploma	Certificate	Support staff
INIA	Headquarters	3	9	32	46	26	38	89
	Provinces	2	1	19	20	33	61	412
	Sub-total	5	10	51	66	59	99	501
IPA	Headquarters	-	6	6	12	5	11	Na
	Provinces	-	-	3	3	6	6	153
	Sub-total	-	6	9	15	11	17	153
INIVE	Headquarters	1	5	9	15	25	119	Na
	Provinces	-	-	1	1	10	11	4
	Sub-total	1	5	10	16	35	130	4
CEF	Headquarters	-	4	8	12	8	11	35
	Provinces	-	1	1	2	3	0	17
	Sub-total	-	5	9	14	11	11	52
Overall	Headquarters	4	24	55	85	92	179	124
	Provinces	2	2	24	26	24	78	586
	Sub-total	6	26	79	111	116	257	798

Source: KIT (2000): Institutional Reforms of the Agricultural Research System under MADER

Note: Numbers in the table need adjustments to take into account formal training, turnover of staff (e.g.: 1 PhD at INIA) and new hires, particularly at the BSc level (INIA has already hired 4 agronomists and will hire soon other 4).

4. Financial resources

The introduction of the Agricultural Sector Program (PROAGRI) in Mozambique has substantially altered the financial situation and procedures of the research institutions under MADER. Although the research system still depends heavily on external support, PROAGRI is managing to shift the trend of a donor-driven project mentality to a more integrated and coordinated planning system oriented towards the objectives of alleviating poverty and increasing food security. PROAGRI has also made arrangements in order to commit most donors to channel their financial support to a single foreign exchange account that feeds into Central Treasury, which in turn, releases funds to central MADER that in its turn re-allocates the available financial resources to research, other ministry departments and provincial directorates. Funds were previously channeled directly to the projects, each of which with a separate accounting record system, different from the official requirements. In most instances, funds of these projects were only accountable to the specific donor, making it difficult to assess the amount of resources allocated to agricultural research. The PROAGRI systems of channeling funds and planning are contributing to an improvement regarding the integration of activities, priority setting, financial management and accountability of research institutions and other departments of MADER.

However, the PROAGRI system still calls for vast improvements, particularly to render it more flexible regarding the predictability in the flow of funds and the timing of disbursements, which has implications in the quality of research particularly as agriculture activities have a seasonal nature. There is also a need to increase the financial support to the research system in order to allow improvements and expansion of the existing infrastructure and equipment so that they could effectively respond to the challenges imposed by their own mandates. Important considerations should also be given to the planning procedures, as presently it is annual-based, while most of the research outputs are only realized in a multi annual time frame. It must, however, be emphasized that research institutions, in collaboration with ISNAR, are actively

engaged in designing tools which are appropriate for research planning and monitoring and also for the evaluation of staff performance.

Table 3.4 substantiates that the amount of funds allocated to the research system are still inadequate, particularly due to the fact that investments are still low for the development of research infrastructure, which together with the necessary investments in the development of human capital constitute the key elements for the success of agricultural research within the country. Although the overall budget for INIA (Table 3.4) is higher compared to other research institutions, when this budget is proportionally allocated to each researcher it becomes substantially lower at this institution (KIT, 2000), which in 1999 was around US$23,650 compared to US $59,260 at CEF, US $47,690 at IPA, and US $34,240 at INIVE.

Table 3.4 Recurrent and capital expenditures (in millions of Meticais) of the research institutions under MADER in the 1993 –1999 period

Institution	Financial Year						
	1993	1994	1995	1996	1997	1998	1999
	(Millions of Meticais)						
INIA	2,001	2,203	3,260	3,723	12,395	8,690	11,057
INIVE	1,246	1,605	2,037	2,596	3,126	5,355	5,593
IPA	919	1,363	2,007	3,212	2,232	4,513	5,550
CEF	600	700	800	3,392	2,898	5,321	4,138
Sub-total	4,764	5,870	8,104	12,923	20,650	23,880	26,339
Provincial stations	1,000	1,100	1,200	2,000	3,350	7,098	6,589
Overall	5,764	6,970	9,304	14,923	24,000	30,978	32,928
Overall (1000's US $)	2,112	1,759	1,483	1,474	2,110	2,717	2,829
Meticais per US $	2,729	3,962	6,275	10,123	11,377	11,403	11,639

5. Institutional Reform of the Agricultural Research System

Agriculture plays an important role and is the key tool to achieve poverty alleviation and food security. In order to achieve these goals farmers need to have a permanent access to new knowledge and technology that are adapted to their agro-ecological zone. This access is only likely to occur with organizations and institutions that work closely with and are able to effectively deliver their knowledge and services to the farmers. In this context, the role that agricultural research system plays in providing such knowledge and services is critical. Experiences elsewhere have shown that wise investments in research can bring high economic and social returns to the country. However, the current agricultural research system under MADER is not yet sufficiently responsive to the various challenges and constraints of agricultural production and development. Indeed, the system needs further improvements to overcome weaknesses in management, planning, monitoring and evaluation, inadequacy of resources including physical and human capital, and also in terms of its research agenda, which has to emphasize participatory methods and integrate the needs of small-scale and commercial farmers. Thus, there is need to develop a strategy that integrates elements that reinforce and build the present capacity of the agricultural research system in which the critical requirements are:

- Empowerment of the system with autonomy and good governance;
- Flexibility and accountability in the management of the research system;
- Greater participation of beneficiaries in the strategic decision-making and evaluation of research results;

- Greater coordination and interaction among public research institutions;
- Decentralization in the implementation of research to the agro-ecological zonal centers;
- Strengthening linkages with extension, farmers and other stakeholders involved in the generation and transfer of technology;
- Reinforcing the public research system with financial resources and with adequate infrastructure and equipment;
- Reinforcing, training and development of the human resource base to carry out and manage agricultural research.

In order to pursue the goals of the agricultural research reforms, a temporary research governing council (CTIA) has been established to improve coordination among research institutions and above all, to facilitate the agricultural reform process. Together with the Executive Secretariat, Research Directors provide governance and guidance of CTIA. Further, MADER has already taken the decision to merge the four research institutions and to re-organize and decentralize research to four agro-ecological zonal centers with the main goal of promoting adequate governance, coordination, rationalizing resources and improving multidisciplinary research at the central and regional levels towards an effective client oriented research. Steps are now being taken to establish the legal framework under which the new agricultural research institute will operate, this framework being still subjected to approval and endorsement by the government. The new research institute, already designated as Mozambican Institute for Agricultural Research (IIAM), will follow an organizational model that comprises three bodies, namely a governing body that includes stakeholders, an executive body managed by a general director and with four directorates, and four Agro-ecological Zonal Centers. Under this new institute, the mandates and functions of the current research institutions will be merged to form two directorates, namely one directorate for Animal Science and another for Crops and Forestry. The model also comprises a training component, which will be integrated in one directorate that will absorb the current Agricultural Training Center (CPFA) and the Center for Agricultural Documentation (CDA).

e. Extension system

1. Background

In Mozambique, public agricultural extension was institutionalized in 1987 as a separate Directorate within the Ministry of Agriculture. It was created by the Ministerial decree number 41/87 with the name of National Directorate of Rural Development (DNDR). The extension system utilized was training and visit (T&V).

The activities of extension were implemented with the collaboration of donors organized in different projects in the provinces. The UNDP through the project MOZ/88/009 and the projects financed by the International Fund for Agricultural Development (IFAD I and IFAD II) significantly contributed to the initial development of common extension methodology and implementation modality of the public extension services.

The World Bank started financing the extension service in 1992/93 through the Agricultural Rehabilitation and Development Project (PRDA) focusing mainly on cashew development (Gaza and Inhambane Provinces) and the Agricultural Services Rehabilitation and Development Service (PRDSA) focusing in all types of agricultural activities (Nampula and Cabo Delgado). This has increased the coverage of the public extension service.

In 1992/93, the T&V system was modified in order to make it more participatory and avoid the top-down approach that existed within the T&V system. Extension workers started to work with groups, rather than only with contact farmers. .

Currently, the agricultural extension services operate in all ten provinces, covering around 55 districts out of the total 128 districts in the country.

2. Organization of the Ministry of Agriculture, Extension Services

The organization of the public extension services is guided by the principle of decentralization and participation. Activities are undertaken at the village level with technical support, supervision and continuous training coming from three levels: the extension network, the provincial extension service (SPER) and the National Directorate for Rural Extension (DNER). The entire system supports producers in their efforts to increase their levels of productivity and income through active participation.

The extension network ("rede" in Portuguese, that may cover a contiguous area that pertains to one or more administrative districts) is the basic unit of the public extension service. The extension network is composed of several teams of extension technicians, their supervisors and subject matter specialists. The extension technician serves as the facilitator and point of contact with farmers. Each extension technician works with around 15 groups of farmers with each group comprising up to15 members, and separated as far as possible within the limits imposed by the extension technician’s travel time, visiting each group regularly, according to an established schedule.

Groups of eight extension technicians form a team and each of them has a supervisor. The responsibility of the supervisor is to ensure that the work of the extension technician occurs according to plan and to provide technical support to them. Accordingly, the team supervisor has to verify that the messages are being adequately introduced and has the responsibility to take technical problems she or he cannot resolve to a higher level. The supervisor should visit each of the extension technicians on a regular basis based on the program of activities. The supervisor participates in training organized by the subject matter specialists. They also meet with the team (extension technicians), to discuss problems and program activities, and carry out some on-farm trials under the supervision of the subject matter specialist.

The extension network covers between one and three districts. Each network has an agricultural (medium level), a livestock and a forestry and wildlife subject matter specialist. The subject matter specialists (and others at the provincial level) have primary responsibility for the continuous training of extension technicians that takes place in the fortnightly or monthly training and technology review meetings. Subject matter specialists receive training on technologies at the provincial level and provide this training to extension workers and supervisors. A large part of the time of these technicians is also spent in the field assisting in the conduct of trials, observing farmers' problems and noting production characteristics.

In addition to the work on technology transfer and dissemination, extension activities at the district include promotion of community self-help activities aimed at creating production and income opportunities through local impact projects. Extension work at the district level also includes support to producer organizations and to communities in natural resource management.

Producer-organization technical officers are responsible for promotion of local extension management committees through which the producers themselves will take on an increasing role in the management of the extension services.

A Supervisor with a diploma level of education manages the extension network. This person is responsible for ensuring that the network's extension program has significant impact. In order to do so, he/she must be creative in leading, supervising, and programming extension activities and must take the initiative in solving problems. The supervisor organizes the fortnightly/monthly training sessions and takes part in the regular meetings at the provincial level. The network supervisor also has responsibility for organizing meetings of the district extension management committee that brings together representatives from the agricultural services, NGOs, the private sector and producers to discuss problems and priorities and to coordinate activities at the district level.

The provincial extension service is the principal coordinating unit of the extension system. The provincial team is led by the provincial head of extension that functions as the provincial supervisor of the extension network. There is a provincial technology officer, who has the responsibility of keeping track of technological options in the province, for training network subject matter specialists, for programming other training events, for conducting the provincial technology review meetings, and for programming and coordinating the collaborative efforts in the province between extension and research.

The team at the provincial level includes the technical staff of the other provincial services within the Provincial Directorate of Agriculture and Rural Development (DPA). There is also technical staff with responsibility for the provincial-level communication activities and for monitoring and evaluation. One of the members of the provincial team will also support the organization and logistics of training events, in collaboration with the Provincial Agricultural Training Center (CPFA).

At the central level, DNER has a national director, a deputy national director and two departments. The head of the Technical Department serves as the national-level technology officer, in support of the provincial counterparts and in collaboration with the research institutes. This department includes the person in charge of training at the national level, a communications section to organize, prepare, or contract out the production of communication materials, and a section on producer organizations (made up of a sociologist and a medium-level staff person) to support the multi-district technical officers in this area. The Technical Department also includes technology officers in the area of livestock. Given the special importance of women in agriculture and the need to incorporate their perspective within the extension program, the Department staff includes a technical officer in gender issues.

The Planning Monitoring and Evaluation Department is responsible for orienting and consolidating the annual work plan and budget preparation process, for monitoring the implementation of activities, and for coordinating extension evaluation studies. It also serves to support the monitoring and evaluation units of the provinces in setting up and operating the information management system.

3. Activity focus of the extension system

The priority areas of focus for which there are messages to be transmitted are:

- Introduction of varieties which are adapted to local conditions
- Crop intensification packages through the use of improved inputs (fertilizers and improved seeds, etc.)
- Improved animal health and production techniques
- Natural resources conservation and management
- Conservation techniques and improving soil fertility
- Improved cultural practices which are adapted to conditions of production
- Diversification of cultural practices
- Multiplication, selection and conservation of seeds
- Introduction of post harvest technologies.

In addition to the work on appropriate technology dissemination, the extension service supports the development of community and producer associations in order to enable them to manage their available resources and support services and promote their participation in planning and implementation process of the extension activities.

The Public Extension Services works in promoting appropriate technology dissemination, in close collaboration with research, line Departments and services, and promotion of community and producer organizations, in close collaboration with NGOs and the private sector

The extension system includes the entire country. This coverage is supplied in part by the public extension service in selected areas, NGOs and other private sector actors where they operate, and by a mass media communications program.

4. Methodology and General Program Areas

The extension services emphasize direct contact by extension technicians with producers, controlling operational costs by always working with groups and not individuals, promoting the lateral diffusion of technologies among farmers, and complementing this work with other communication media. Consequently, the overall methodology of the extension service covers five areas: i) direct contact, participatory technology development and dissemination, ii) promotion of farmer-to-farmer dissemination, iii) support for community and producer associations to manage their available resources, iv) special activities in support of the emerging group of commercially-oriented farmers, and v) mass media communications.

Direct contact activities: Every extension technician must serve a wide area as a catalyst for introducing new technologies and ways of utilizing available resources. To achieve broad coverage while keeping costs down, each extension technician works with groups of farmers from 12 to 15 members distributed over as large an area as is feasible within the limits imposed by travel time. The goal for each extension technician is to maintain direct contact with about 225 farm families.

The methodology emphasizes direct linkages with adaptive research program, namely diagnostics and research on –farm, which counts on the active participation of the farmers. Family sector production is a complex process with low levels of security and resource endowments and high levels of risk. Family production units have to be managed in a balanced

way to avoid disasters during critical periods. The technological changes to be introduced into the family sector must be well tested with the farmers and the adoption process should emphasize sustainable impact and gradual production increases. Consequently, in addition to the use of demonstration plots, this participatory approach requires that extension technicians encourage farmers to evaluate alternative technologies under their own production conditions, on their own "adoption plots" as an intermediate stage between the demonstration and full scale adoption.

Promotion of farmer-to-farmer dissemination: In all extension systems, the vast majority of message dissemination takes place among farmers themselves. The primary function of the extension agent is to facilitate and get the process started by introducing messages either from the research program or from observation of other farmer practices. Three out of four families covered by the extension service will receive messages through direct contact with other producers. Major portions of extension activities directly target this lateral diffusion of technology. These activities include field days on selected farms in which the farmers themselves demonstrate and explain their practices, taking a group of farmers to visit other areas to see for themselves what others are doing and discuss it with them, providing support for farmer-trainers to spend time in a different village to demonstrate a technology they have found productive, and the identification and training of farmer-leaders to enhance their skills and effectiveness in transmitting their knowledge to others. Another important activity is the organization of agricultural fairs where producers and extension services can demonstrate the results of their efforts.

Enabling communities to take greater control of their resources: A key component of the extension program is the empowerment of local groups to manage their available resources. These include natural resources, the government or NGO programs that support the community, and the economic resources that can be pooled to provide services beyond the reach of individual initiatives. The extension services supports the National Forestry and Wildlife Directorate in promoting community-based natural resource management. Various non-governmental organizations promote the formation of community or producer associations and in many areas the Ministry's extension technicians work in close collaboration with these, to learn from their experience and take advantage of their ongoing activities. As outlined above, multi-district technical officers are responsible for supporting producer and community organizations, which are also responsible for ensuring that NGO activities in the districts are fully incorporated into the extension program.

Support for the emerging group of commercially oriented producers: The target group of the MADER extension service is the family sector. Nevertheless, the emerging group of commercially oriented farmers also requires support, both from the public sector and private agricultural services. The current level of input and credit services is very low or nonexistent in most rural areas, and marketing remains one of the most serious bottlenecks to expanding production. This situation is changing rapidly however, and will undoubtedly undergo significant transformation over the coming years as infrastructure improves, production expands and economic liberalization progresses. Over time, many family sector farmers will produce primarily for the market and the group of commercial producers with access to inputs and credit will become a major segment of the farm population.

The extension program supports this process in several ways. Technical staff members at the district and provincial levels spend part of their time providing information to commercial

producers and this is reflected in their job descriptions. In addition, DNER also continues to work with commercial producer associations.

Mass media communications: The extension service utilizes mass media to supplement and complement face-to-face communication of extension technicians with farmers and farmer-to-farmer dissemination activities. The primary vehicle for this purpose is radio broadcasts in local languages throughout the country. These radio broadcasts are used to reinforce the current messages of the extension technicians in that province and also to augment farmer-to-farmer dissemination by, for example, interviewing farmers about their practices and identifying villages where successful experiences can be observed and promoting collective radio listening groups. Video is also used for this purpose, as well as theatre, posters and other media.

5. Outsourcing

The agricultural extension policy and strategy within the PRAGRI envisage the establishment of a national extension system that is composed of the Ministry's extension activities (the unified extension service) and the promotion of collaboration of other non-governmental and private sector agricultural service providers (the national extension system). The policy and strategy are founded on the principle of promoting the active participation of producers to ensure that extension effectively responds to farmer's problems and needs.

The Extension Master Plan includes as its primary strategy the promotion of publicly- financed extension that will be open to multiple financial and delivery arrangements. The arrangement includes outsourcing, cost sharing with local extension structures and cost-recovery from farmers, farmers' groups and associations. It is anticipated that pluralistic delivery of extension services (delivery by both private-sector commercial enterprises and not-for-profit non-governmental organizations (NGOs), farmer organizations) will advance to attain greater cost effectiveness and enhance farmer responsiveness compared with the situation where public sector extension is the sole provided. The outsourcing of extension services can result in publicly financed extension which is sustainable, demand-led, more accountable and responsive to farmers' needs and more operationally efficient.

As a result, the public extension service is in the process of contracting extension services to the private sector in two districts of two provinces on a pilot basis. The districts are Murrupula in Nampula province and Nicoadala in Zambezia province. The pilot activities are expected to start in the 2002/2003-crop season. Based on the experience gained with these pilot activities, other districts will be covered in the coming years.

6. Opportunities and Limiting Factors within the Public Extension Service

Positive factors:
For the future, the main positive factors for the extension system are the following:

- Existence of policy and strategy that support and guide the efforts of the extension system (PROAGRI, Extension Master Plan)
- Promotion of pluralism in the delivery of extension service with state funding and private sector delivery (outsourcing). The public extension service is in the process of implementing an outsourcing program in two districts of two provinces on a pilot basis.
- Promotion of collaboration and cooperation with other extension partners such as NGOs and the private sector within the framework of the National Extension System (SISNE)

- Implementation of the process of decentralization of extension activities to provincial and lower levels (both planning and implementation)

Constraints:
The main constraints for the extension system are the following:

- Inadequate human resource base in terms of quantity and quality; only around 481 frontline extension workers located in 55 districts.
- Absence of career policy for the major job categories of the extension system.
- The majority of extension workers is employed on contract basis and therefore has little job security.
- High level of staff turnover, especially at the frontline extension level mostly triggered as a result of low salary level and job insecurity. Many staff members seek employment with NGOs since they offer higher salaries and are more reliable in providing salaries.
- Inadequate technological options within the system that can serve the requirements of the producers.
- Little institutionalization of coordination with NGOs and other partners.

f. Current state of market liberalization

1. Output markets for major crops

State control over prices for agricultural commodities is almost completely gone, with the major exception of cotton. The Mozambican Cotton Institute establishes the guidelines for producer prices for cotton, based on world prices, ginning efficiency and local production costs, with input from the Cotton Working Group, a set of private and public sector actors in the cotton sector. There are still concessions granted to private enterprise to develop cash crops in regions. Cotton and tobacco are two crops with concessions. These are based on the idea that side-selling (producers selling to buyers outside of production contracts) will collapse the industry and that the private sector will not invest unless guarantees are given. Basically, within a concession, farmers participating in production of a crop must sell that crop to the concessionaire and sales to other parties are prohibited.

There are national institutes for three crops considered key on the economy: cotton as mentioned above, sugar, and cashews. These institutes help to coordinate activities across producers and processors, but have also had more active roles in setting prices and rules for operations. They are gradually being privatized and their role reduced to facilitators.

The parastatal ICM was once the major maize grain trader in the country and still has substantial warehouse capacity throughout the country. It has gradually lost its active role in the markets and now is primarily run as a for-profit agency, leasing warehouses to the private sector. A recent study was undertaken to propose new actions, but the results of the study are not yet available. It is likely that full privatization, with sales of all warehouses, will be recommended, although what form that will take, remains to be seen.

There are still some efforts at the local administrative levels to control marketing, specifically to control the sales of maize for export from the district or the country (Whiteside, 2002). District administrators express concern that the farmers will sell so much that food security in the area will be threatened and no food security stocks available. These actions are not supported by national law, but reflect the disagreements within Mozambique as to the role of the government.

2. Seeds and fertilizers

Both before and after liberalization, smallholder use of fertilizers is low. The government currently is involved in the KRII program of agro-chemicals and implements from Japan. There are stocks of these still in warehouses under government control, and the Fondo Fomento Agrario (FFA) is responsible for determining how best to release these products to the private sector for sales, or whether to use them in special government programs for technology demonstrations. New arrivals of agro-chemicals under this program are doubtful. Otherwise, private traders can import and sell on the domestic markets, in accordance with their individually signed international agreements with vendors and with local large-scale agro-industry. Outside of plantations and the commercial farm demand for fertilizers, there is still very little effective demand from small scale producers, thus limiting the profitability for the private sector. Working with farmer associations and NGOs, the large-scale private sector sees a way to serve a dispersed clientele with reduced costs, but the development of rural retail fertilizer sales is still a challenge. With the lack of rural sales outlets, the sustainability of technology packages using agro-chemicals remains doubtful, but it may be that extension programs for fertilizer use will help to create the effective demand that will enable private sector to expand services, if these programs use private sector channels for inputs.

During the years after the Peace Accords, SEMOC, partially owned by the Mozambican government, was responsible for seed multiplication, processing, and sales in the country. It depended largely on the emergency programs as clients with the government and NGOs distributing the seeds. SEMOC did not have any large private sales base, so there was no network of rural retail seed vendors. As the emergency programs wound down, the effective demand for seeds declined dramatically, and SEMOC went from a high of 14,000 tons per year of seeds sold to less than 3,000 tons per year (Howard, et al. 2001). SEMOC has been privatized and other seed companies are being established in Mozambique, so the government role has shifted to a more facilitating role, with one major exception. In principal, INIA supplies the foundation seed for seed multiplication to private seed multipliers, including the companies and farmers associations. Lacking the capacity to respond, INIA has been combining efforts with UEM, international centers, and NGOs to help provide the needed seeds. The public sector regulations for imports and certification do not facilitate the sector and are due to be revised under the new strategy for seeds. There is continuing public support for some seed multiplication, particularly for commodities not seen as attractive to the commercial sector. The increasing number of public/private partnerships are seen as a way to ensure seed availability in rural areas, as well as increase rural incomes, as some farmers and farmer associations become specialized in seed multiplication. NGOs (CARE, World Vision, and Africare) are training rural agents for seed and other inputs sales, while SEMOC, after efforts at greater rural coverage, is restricting its expansion of outlets to more rural areas due to financial constraints. Thus, liberalization has lessened the flow of improved seeds to rural areas, as the emergency distribution programs are shifted to commercial sector activities where the commercial sector is still weak.

3. Impacts

The effects of market liberalization are hard to judge in Mozambique, because liberalization occurred in an economy that had seen its way through an exodus of private sector agents at Independence, a protracted civil war that targeted productive assets, several droughts including a major regional drought in the early 1990s, and a government without many resources. By the

time of the Peace Accords, the government was open to working with the international community and rapidly changed policies, with economic growth the result.

Most output market activities have been privatized, notably the large public sector marketing and processing of maize. There are active markets in maize, beans, and groundnuts, both in the center and the north, as a combination of informal and formal traders constantly seeks new markets. They are mainly constrained by transport problems, but also markets for the goods, which can be very seasonal. The informal sector boomed in the early days of liberalization and has continued to prove dynamic in finding opportunities. Farmers away from the main transport routes, however, have probably benefited little from this increase in markets, as evidenced by the low market participation rates.

The cotton sector is still not completely liberalized and the sector is going through very difficult times, with low international prices for fiber at a time when there is competition for domestic production. Processors have high per unit costs when they are not working to capacity, and the presence of multiple buyers on the market limits to ability of some firms to compete internationally.

Cashew market liberalization is still in process and while domestic prices are liberalized, there are still some export taxes on raw cashew exports, based on infant industry criteria for protecting domestic cashew processors and employment in the sector. The debate continues as to who is being helped and who hurt with the current set of tariffs (Mole, 2000). Primarily smallholders grow cashews, and producer prices have not shown the increase that would encourage the productivity enhancements needed to return Mozambique to high cashew exports.

For the input markets, development of the seed subsector has been constrained due to lack of demand, lack of sufficient varietal development capacity at INIA as well as slow certification of varieties. The private sector has begun to move forward with some crops, where the market potential is perceived to be high, but their work is still concentrated in the main cities, and the seed companies are now working with NGOs and farmer associations to get both supplies and sales. Farmers continue to have difficulties getting seed.

As will be discussed in section 6, financial market liberalization resulted in major declines in finance available for agricultural production and trade. The liberalization of financial markets has clearly limited the funds available for investment in agricultural production, particularly for small holders. The lack of collateral and high transaction costs will limit private sector willingness to invest in production, but there are new efforts for rural trade and agro-processing that are promising for increasing liquidity in some areas.

4. Biotechnology, Breeding and Seed Systems

a. Prevailing cropping systems of the country's principal agro-ecologies

1. How major foods are used at home

There is very little diversification in the source and in the way food is prepared and used in a given region and at the household level, particularly in the rural area. The content of food intake is generally not adequate to meet all nutritional requirements of most households and as a result, there is marked evidence of acute and chronic malnutrition in many areas across the country,

especially among women and children. In addition, processing mechanisms are basic and labor consuming, and the quality of the end product is not up to market standard. There are initial efforts to import technologies to assist farmers to process their produce but further research is needed to adapt to the farming systems and the needs of the market.

By and large, there is very little food intake from animal sources. Staple food across rural areas comprises cereals and/or cassava as sources of carbohydrates, which are consumed in combination with leaves and grains of leguminous crops as source of proteins. Maize and cassava are the most important source of carbohydrates, both crops being widely produced in Mozambique, with cassava mostly grown in agro-ecological regions II, V and VII and maize particularly cultivated in regions IV, VII, IX and X. The bulk of the harvested maize is pounded/milled to yield flour. Maize cobs are also used green (as a vegetable), either roasted or boiled, both ways enjoyed as a snack. Maize grains are also used in the preparation of local drinks; either sweetened beverages or fermented alcoholic drinks.

Cassava parts used for household consumption comprise both leaves and roots. Cassava leaves are an important source of vitamin A and C and also of protein and minerals such as iron and calcium. Cassava leaves are generally pounded to form a paste, which is then boiled together with different foodstuffs such as: pounded groundnut, coconut milk, crabs, dried prawns, or other sea or animal products, but all these mixtures can vary across different regions in accordance with the availability of food resources and food habit. For instance, a simple combination of cassava leaves could include water and salt only. Cassava roots are consumed either fresh or dried and, as fresh cassava, roots are eaten as raw or roasted, but boiled in water is the most common form. The bulk of the harvested cassava root is dried and then pounded/milled into flour for meal preparation, known as “karacata” in the northern part of the country. In Inhambane Province, fresh cassava is grated, fermented, dried and fried, all these steps leading to an end product called “rale,” known as “gari” in West Africa. When cassava roots, especially those with a high level of cyanide, are not processed properly (short cut), the final product will contain high levels of cyanide. This phenomenon is still causing severe disease problems (konzo) in some of the drier areas of Nampula Province where the population relies on a monotonous cassava diet. In some parts of the country cassava roots are also used as raw material to produce an alcoholic drink.

The most common leguminous crops in Mozambique are cowpeas, mung beans, common beans, groundnuts, and pigeon peas. These crops are generally consumed as grains, but leaves of cowpea and in some areas leaves of beans are also used in meals. Commonly, harvested leaves of cowpea are boiled in water in various combinations with tomatoes, onions, pounded groundnuts and, depending on the region, dried fish or prawns are also added to the dish, eaten as a sauce (“carril”). In some areas leaves of cowpea are boiled and then sun dried for further use. The consumption of grains of these leguminous crops could be made either fresh or dried, the former in the case of cowpea, being generally used as pods, commonly boiled in water and enjoyed as snack. The use of dried grains, generally involves a process that removes the outer layer (tegument), particularly in the case of cowpea and mung bean. The whole dried grain is generally used as carril prepared with boiled water in combinations with different foodstuffs, as for instance, tomato, onion, cabbage and coconut milk. Cowpea and pigeon pea grains are also ground into small pieces to take part in different dishes. Pods of groundnut could be harvested immature and in this case they are boiled and eaten as snacks. There are a number of uses when mature groundnut pods are harvested. Depending on the region, it can be eaten raw, roasted or boiled, while in other regions, especially in the southern areas, pounded groundnut is an

important component in the preparation of different dishes. Cashews are usually eaten roasted as a snack or ground into a paste to use like groundnuts.

2. Principal Biotic and Abiotic Constraints for Crop Production

Based on climatic variation, mainly rainfall and to lesser extent physiography, the country is divided into ten different agro-ecological regions (Figure 1.4), each comprising different types of farming systems. Under this wide range of agro-climatic conditions, crops experience a range of challenges that limit crop production and yields, especially due to different abiotic and biotic constraints. Among abiotic factors, low soil fertility and drought are by far the most important constraints for crop production. Low soil fertility is mainly due to nitrogen depletion from the soil, which is widespread across the country (Figure 4.1). Research data also shows a response to applied phosphorous in maize in some parts of the country, indicating that crops might be under stress when this mineral nutrient is not added to the soil. Soil infertility is also caused by low pH or soil acidity, but the importance of this is mainly observed in elevated areas with high mean rainfall values. In order to minimize the effects of low soil fertility, farmers generally practice shifting cultivation, but in many areas where there is scarcity of land, the fallow period is increasingly becoming shorter. This decrease in the fallow period is of particular significance along the sandy soils of the coastal belt in the southern provinces where high population density exerts a high pressure on land used for agricultural purpose. Examples of this phenomenon also exist in Niassa province in which soil fertility depletion causes farmers to move away and settle their farms in areas far away from their original villages.

Countries in Southern Africa recognize the importance of stresses caused by low soil fertility and drought, which cyclically affects thousands of rural families across several countries within the SADC region, who presently have to rely on food aid for their survival. In order to address the effect of these two stresses, agriculture research institutions within SADC are collaborating within the framework of the Southern Africa Drought and Soil Fertility (SADLF) project, which operates under the auspices of CIMMYT regional office in Zimbabwe and with the financial support from the Swiss government. The major goal of this project is to develop and disseminate maize varieties with advantageous characteristics that confer tolerance/resistance to these two abiotic stresses, the trait most important and highly heritable being the interval from silking to anthesis due to its importance for flowering, which is the most critical stage for the success of maize production under stress. SADC countries are pooling together their maize germplasm for regional breeding and testing and, as a result of this networking several countries in the region are in process or have already released varieties with a good performance under low soil fertility and moisture stresses.

In addition to SADLF project, several countries in the region, namely Malawi, Zambia, Zimbabwe and Mozambique, have come together in soil fertility network that operates from the CIMMYT/Zimbabwe office with the financial support from the Rockefeller Foundation. The project emphasizes low cost technologies that ameliorate the fertility status of the soil. The aforementioned countries and Tanzania have also joined their efforts to develop and disseminate technologies based on agro forestry species that enhance soil fertility. ICRAF is the implementing agency of this initiative, with offices in all these countries and, with the financial support of the Canadian Development Agency and USAID, these financial supports for Mozambique being confined to parts of Tete province.

Crop production is also limited by several biotic constraints. Some of the most important pests and diseases for the major crops are listed in Table 4.1 and 4.2 below. As shown in those tables, researchers are working to develop crop management techniques to minimize threats, as well as the development of varieties with resistance.

b. National Crop Improvement Research Profile

Several organizations are currently involved in crop improvement programs, mainly INIA, the Faculty of Agronomy under UEM (FAEF), Seed companies and NGOs. By and large, NGOs are concerned with low cost technologies for crop production and conservation, testing and selection of new crop varieties, particularly under on-farm conditions and with dissemination of crop varieties that have already proven to be specifically adequate and adapted to farmer's conditions, most of these activities being carried through field demonstrations, generally accompanied by local seed production. In order to develop these activities, NGOs establish linkages and partnerships with INIA, FAEF, seed companies and International Agricultural Research Centres (IARCs) from the CGIAR system. Although NGOs concentrate most of their efforts on the development of food crops targeting food security, there is now a growing concern with raising farmer's income through crop diversification and traditional cash crops with emphasis on cashew nut, sesame, sunflower, paprika, groundnut, and pigeon pea.

ADRA, for instance, has, in the last few years, been involved in applied and adaptive cashew research, mainly to develop new plant materials that are resistant/tolerant to major pests and diseases (Helopeltis sp. and Oidium) and to develop sound crop protection practices, including crop sanitation. Recently, ADRA expanded its cashew research activities to a third province in Gaza, with the financial support of the European Union that launched a tender with the goal of improving food security through crop diversification for areas in which the prevailing farming system is based on cashew or on cotton crops. In addition, World Vision, Care International and Africare are three of the most active NGOs in promoting other cash crops and their interventions include the provision of improved seeds obtained through IARCs and the establishment of linkages with national and international markets.

Care International is also promoting oil presses at the rural community level for processing sunflower seeds. Regarding this crop, Care International has established connections in the past with Catholic University's Faculty of Agronomy (FAEF) to test their sunflower varieties under diverse on-farm conditions and with INIA's research station in Nampula for seed multiplication, with the latter collaboration now being expanded to other crops, including pigeon pea and cowpea.

Other NGOs promote cash crops but with no direct intervention in the implementation, being the case for TECHOSERVE that is currently promoting the development of banana (Musa acuminata). This NGO has already taken steps to involve a renowned private company from Honduras (Galil Agribiotech) in this business. Staff from this company recently visited the country and are enthusiastic about being involved in the export of this crop from Mozambique. TECHNOSERVE has also established connections with a relevant agricultural research institute from Honduras (Fundação Hondurenha de Investigação Agronómica-FHIA), who have not only sent a representative to visit and train banana farmers in Mozambique, but will also provide planting materials, part of which to be planted in several locations in replicated trials conducted in collaboration with INIA.

The private sector is also involved in crop improvement, particularly through seed companies, mainly SEMOC/SEED Co and PANNAR. Regarding crop improvement, PANNAR has had a limited intervention within the country, which is confined to testing for registration of their crop varieties, mostly hybrid maize. This activity is developed through their partners, namely NGOs and INIA. The crop improvement program of SEMOC/SEED Co is limited to maize, since other crop improvement programs (including rice breeding), are no longer being developed for market reasons. The maize program of SEMOC/SEED Co has been down sized and, emphasis is now for hybrid development in sharp contrast with its previous program that gave premium to the development of open pollinated varieties. The company is also collaborating with INIA on screening for disease resistance of the Quality Protein Maize (QPM) germplasm, which is characterized by enhanced nutritional value.

Apart from these two seed companies, a cotton company, AGRIMO, is also involved in crop improvement. This company, which operates in the Zambezi valley, developed a partnership with the Faculty of Agronomy under UEM (FAEF) to implement a crop diversification program with the financial support from the European Union. This program involves on-farm germplasm evaluation of several crops from the region, including maize, sorghum, pigeon pea and cotton. Previously, the now- bankrupt cotton company, LOMACO, had developed a similar partnership with CIRAD, a French research institute, but this program is no longer in operation. The cashew research program under the Entreposto Group is headed for a similar fate.

Conversely, coconut research is now increasing its activity through MADAL, a private company that has been involved in the coconut business for many years. The research operation of MADAL in Zambezia province is being implemented in collaboration with INIA. Through this program the company has sent one of its coconut research staff members for short training course in Ivory Coast. In addition, the company is an executing agency in a tripartite project with financial support from Portugal, involving INIA as the implementing agency and COGENT (Coconut Genetic Network) from IPGRI (International Plant Genetic Resource Institute) as the international and supervision agency. The goal of this project is to evaluate the genetic potential of several hybrids, which in the first phase are being tested in numerous coconut areas around the world. The second phase will involve coconut germplasm collection in several zones of coconut production within the country and their further molecular characterization in Portugal. However, one of the most important constraints for coconut production in Mozambique, is the lethal yellow disease presumably caused by a micoplasm, which is devastating large areas of coconut in Cabo Delgado and Zambezia provinces, threatening the livelihoods of thousand families who rely on coconut production for their survival. It is likely that the French government will provide financial support for research technologies that mitigate the effect of this disease. This financial support will be also extended to address relevant research issues on cashew and cotton crops. INIA also counts on the support of COGENT to obtain coconut germplasm for testing and further breeding and, steps are being taken to develop multi site facilities for this work. The collaboration between INIA and COGENT is also being extended to coconut utilization and a joint project has already been drafted awaiting financial support.

INIA and the Faculty of Agronomy of UEM are conducting most of the crop improvement programs in Mozambique. The Faculty of Agronomy focuses its research activities on the evaluation and selection of groundnut varieties for Southern Mozambique and also on breeding of sunflower with financial and technical support from Italy. INIA concentrates most of its efforts on research of basic food crops that include maize, sorghum, millet, rice, grain legumes (cowpea, beans, groundnut and pigeon pea), cassava and sweet potato. The crop improvement

program under this institute also includes cash crops, namely cashew and cotton and recently, coconut, Irish potato, tobacco, fruit, and horticulture crops are all being incorporated in the research agenda. It must, however, be emphasized that research on these latter crops, particularly Irish potato and tobacco, is only being conducted in Niassa province due to the pressure exerted by some of the research stakeholders, particularly the local government.

Due to the lack of qualified staff in other research areas, most of the improvement programs under INIA involve agronomy, crop protection, seed multiplication, evaluation and selection of crop varieties from IARCs. Preliminary crop improvement is carried out across the net of experimental stations spread over the country, followed by on-farm testing at the advanced stages of research. Relevant research results are then meant to be disseminated to farmers through the public extension network and other partners, but the development of this activity has been rather slow, partly because many researchers and extension workers lack skills to transfer their research knowledge to users. To overcome this slow release of research results, there is a great need to strengthen the communication sector within the institute, which is supposed to develop written research materials for different users. The communication sector will have a very important role in assisting INIA through the production of posters, pamphlets and other materials to educate and provide farmers with alternative technologies.

In contrast with other crops, maize and root and tuber (cassava and sweet potato) research programs contain breeding aspects in their work plans. The maize-breeding program at INIA has been in operation for several years and emphasis has always been on open pollinated varieties. This program, which counts on financial support from the Rockefeller Foundation, is now concentrating half of its breeding program on the development of QPM varieties for different agro-ecological conditions. In order to be able to select against major diseases and to fully exploit the genetic potential of maize materials, the program develops its main breeding activities in two experimental stations that differ in terms on the type of disease pressure and agro-climatic conditions. The program is making significant progress; it has for example recently released a QPM variety and is in the process of releasing three new varieties, each for low, middle and high altitudes. However, further support is needed in the area of molecular markers for inbred line development and also provision of training and associated equipment for basic seed multiplication.

The root and tuber improvement program has expanded its scope of work by integrating cassava-breeding activities in their agenda for the first time, and it also counts on financial support from the Rockefeller Foundation. This new breeding program is concentrated in Nampula province and its current goal is to develop varieties that are resistant/tolerant to Cassava Brown Streak disease that is devastating large parts of the cassava crop, particularly along the coastal strip in the northern provinces where the crop is a major staple food. Together with this new breeding program, the root and tubers improvement program also counts on financial support from USAID for multiplication and distribution of cassava stakes and sweet potato vines. This USAID funded project, that has been extended to next March (2003), is being implemented with the technical assistance of IITA and has a strong insertion within the Southern Africa Network for Root and Tubers (SARRNET) with the headquarters in Malawi. However, the sustainability of the root and tuber improvement program relies on further training of most of their researchers, who presently are only degree holders. In addition, to strengthen this program there is need to develop tissue culture laboratories (especially in Nampula), in order to guarantee that cassava and sweet potato materials delivered to farmers are free of diseases.

Table 4.1 Important Diseases of Major Crops

Crop	Type/Name of the disease	Research Efforts	Remarks
Maize	Downey Mildew (Pernosclerospora sorghi)	Development of resistant varieties	Important in the south, particularly with late planting.
	Maize Streak virus	Development of resistant varieties	Most important in the south, particularly with late planting.
	Grey Leaf Spot (Scientific Name)	Evaluation of germplasm from other research centers.	New disease recently observed in high altitude areas. Important disease in some neighbouring countries (ex: Swaziland)
	Ear rot (*Fusarium spp* and *Diplodia spp*)	Trait considered in the selection criteria in maize improvement program.	Across the country, especially in the northern areas.
Sorghum and Millet	*Helminthosporium spp*	None as yet	Across the country.
	Antracnose (*Colletotrichum spp*)	None as yet	Across the country
	Cercospora sp	-None as yet	Across the country
	Flowering rot (*Fusarium sp)*	-None as yet	Occurs in central and northern provinces.
Rice	***Pyricularia oryzae***	Crop management	Important for central and northern provinces
	Helminthosporium oryzae	Crop management	Across the country
Cassava	Cassava Brown Streak Disease	Development of resistant/tolerant varieties	High incidence in the coastal belt of Nampula and low coastal belt and mid altitudes of Zambezia
	African Cassava Mosaic Disease	Germplasm evaluation	Across the country
Cowpea	Cowpea Golden Mosaic Virus (Scientific Name)	Germplasm evaluation	Transmitted by *Bemisia tabaci,* which occurs across the country
Beans	Angular leaf spot (*Phaeoisariopsis griseola*)	Germplasm evaluation	All humid areas in the northern provinces. In the south only important when sprinkler irrigation is used
Beans (cont)	Rust (*Uromyces appendiculatus/phaseolis*)	Germplasm evaluation	
	Antracnose (*Colletotrichum spp*)	Germplasm evaluation	Most important in high altitude areas
	Bacterial blight	Germplasm evaluation	Prevails in warm areas
Cashew	Oidium (*Oidium anacardii Noach*)	Crop management. Early stages of germplasm evaluation	More important in the northern areas
Coconut	Lethal Yellow Disease	None as yet	Zambezi and C.Delgado

Table 4.2 Important Pests of Major Crops

Crop	Name	Research Efforts	Remarks
Maize	Stem/ear borers	Evaluation (against Chillo partellus) of the parasitic wasp from ICIPE (*Cortesia flavipes*)	Across the country
	Termites	Crop management	Across the country
	Weevils	Germplasm evaluation	Across the country
Sorghum and Millet	Borers (as for maize)	None as yet	Across the country
Rice	Rats	-	Across the country
	Birds (Quelea-Quelea)	-	Important in south and center
Cassava	Cassava Mealy Bug (*Phenacoccus manhiot*)	Release of parasitic wasps	Moderately important at Inhambane
	Green spider mite (*Mononychellus tanajoa)*	Release of thrips (*Typhlodromallus aripo)* developed by IITA	Long time in northern areas, now dispersed to center and south
Cowpea	Vegetative stage (aphids, ootheca spp); Flowering (thrips); Pods (*maruca testulalis*); Storage (weevils)	Integrated pest management (with botanical insecticide) using farmer field schools	Across the country
Beans	Bean fly (*Ophiomyia spp*)	Crop management	Across the country, especially in high altitude areas in the north
Groundnut	Aphids (*Aphis craccivora*)	Crop management	Across the country
Cashew	Helopelthis sp.	Crop management	Across the country, especially in the south

One important consideration of the current improvement program under INIA, is the fact that there is a limited number of qualified staff to conduct research activities. For instance, the whole system only counts on two MSc holders in the area of entomology (one exclusive for cashew), and two MSc holders in the area of crop breeding, one being for cassava and the other for maize. There are only three nationals that have been trained to a PhD level; one being involved with agronomy, including evaluation and selection of grain legumes, the other being involved with sorghum improvement and the third being currently involved with administration issues. There is a lack of expertise in several other important areas of research, which are not yet covered or are covered by researchers holding a BSc degree such as in the area of phytopathology. Despite the importance of some crops, there is lack of breeders for them including rice and grain legumes and none of the staff in training are undertaking the courses to concentrate on these crops. Food technology is another important research area that needs attention for it to develop, particularly because there are high crop losses and little value adding under farmer's conditions. In the past, INIA has played an important role in food technology research and counted with well-equipped cereal and chemistry laboratories, which were also used to provide services for food quality control. Formal and informal training of research staff, rehabilitation of infrastructure and acquisition of equipment and tools would all be needed in order for INIA to resume the important tasks of developing appropriate technologies for marketing, for food

conservation in the rural community areas and to provide services related to food quality control and training. The United Nations Development Program (UNDP) has already expressed their interest in INIA playing a role in the training of relevant interveners in the food chain, due to the prospect of Mozambique increasing the level of agriculture food export. Regarding food quality control, there is an Institute for Quality Control (INNOQ) that deals with regulatory framework within the country, and INIVE is also involved in quality control for animal products, while the Ministry of Health deals with hygiene control for some products, as for example, water for consumption.

Biotechnology is also an area of work that needs development to assist agriculture research. While Mozambique is not expecting to intervene in the field of biotechnology transformation, it is important for them to develop selected biotechnology techniques. One such tool is tissue culture, which will assist in the dissemination of improved varieties free of diseases, particularly for cassava that is a staple food in many areas across the country. The other important technique is in the field of molecular markers, which are an important tool for breeders in the selection process and to characterize germplasm of many crop species. Regarding biotechnology development, the country is now taking its first steps to set up a biosafety institutional and regulatory framework dealing with transfer, manipulation and use of genetically modified organisms. To accomplish this task a multi sector-working group, under the coordination of INIA, has already been formed and funds will be partly provided by the Global Environment Facility (GEF). The result of this work will be important for decision- makers who recently had to deal with pressures related to the transfer and use of transgenic maize in the context of food aid for several SADC countries stricken by the effects of drought. The results will also be important for agricultural research that has to deal with testing and evaluation of transgenic crops, particularly for those crop varieties that were or, will be, genetically transformed to provide enhanced nutritional value or resistance/tolerance to major pests and diseases.

c. Seed exchange

Agriculture in Mozambique is mainly developed by small-scale subsistence farmers who cultivate small portions of land in a wide range of multi-cropping arrangements, with very little or no use of improved inputs (Howard et al., 2001). Seeds constitute one key input for food security, a fact that is well perceived by small farmers who usually select and save part of their own farm production and use it as seed for the next cropping season. Storage and conservation methods used for seeds are generally distinct from those used for farmers own consumption with the diversity of these methods varying in compliance with crop species, environmental conditions and with resources that are locally available.

Although the contribution of improved seeds to increase production and productivity is well recognized (Smale and Jayne 2002), there is not only an ample use of traditional varieties (also known as local varieties or landraces) but also the informal system of seed exchange still prevails within the country. This situation is mainly due to the high price of this input, lack of capital/credit for farmers to purchase improved seeds, low coverage of improved seed markets with implications in seed availability, and many also consider that farmers have a low perception of the value of improved seeds, fact that in many instances is also associated with the quality of seed supplied. Consideration should also be given to variety traits that are important to farmers, such as palatability, storage ability and yield stability.

Together with the prevailing means of saving his/her own seeds, the informal system also includes mechanisms such as seed donations from relatives and exchanges for labor, products and other means. Seed exchange also occurs in rural markets where farmers purchase grain from which they select their own seed needs, but farmers exercise some caution in using this secondary source of seed, as farmers are aware that not all varieties are adapted to their own conditions. In Kenya, Malawi and Zambia, improved maize varieties gained widespread use through the combination of research to develop maize varieties appropriate for local production and consumption needs, and of market (or parastatal) mechanisms to get the seeds produced and available to farmers (Smale and Jayne 2002).

During natural disasters caused by floods, drought or other means, seed exchange can be extended to other villages or regions, generally with similar environmental conditions. However, under these circumstances the local grain markets are generally the main source of seed exchange (ICRISAT, 2002). Blanket seed distribution has also been used to assist the poorest farmers to re-initiate cropping their land after the emergency period and often, this free distribution goes beyond the emergency period. Large amounts of seed and tool kits have been delivered and continue to be delivered to the stricken areas, using crop varieties from neighboring countries, as there is usually a shortage of seed reserves within the country to attend emergency requirements. Considering that crop varieties introduced under emergency situations are not necessarily adapted to local conditions and farmers' needs, there is now a growing concern within the SADC region on the need to harmonize the seed legislation and varietal testing procedures, and to conduct studies to group regions with similar agro-ecological conditions. It also appears important to review the current seed policy in order to accelerate the procedures for varietal release, so that farmers could have access to new varieties as soon as they are released from research institutions and seed companies.

1. Seed Industry

Although the seed sector in Mozambique has existed for many decades, its development was still at the early stages at the time the country reached its independence. By then, most of the interventions were mainly to meet the needs of commercial farmers for crops such as cotton, with very little emphasis given to subsistence food crops. The Mozambican Institute for Cereals (ICM) was the government institution in charge of seed supply and its main scope of interventions involved: 1) small scale seed multiplication which reached a total of 300 ha in 1973 for rice, wheat, peanut and soybean, 2) small amount of seed import for further multiplication or hybrid imports for sale; and 3) Purchase of surplus of grain production, part of which were then delivered back as seeds to the farmers. There were also private companies involved in seed imports and distribution, but only in small amounts and particularly for horticultural crops. Further development of this sector occurred with the introduction in 1974 of a legal framework for seed production and trade and also the establishment of a seed laboratory.

Major steps have been taken in the seed sector since the country gained its independence, the first one being the establishment of a National Seed Program entity (PNS) in 1996/97 with the support of a UND/FAO project and later, in 1978, with the support of the Mozambique Nordic Agricultural Program, also known as MONAP (Freire and Banze, 2001). Under PNS, major emphasis was given to basic seed production within research experimental stations and commercial seed production within the emerging para-statal company. Later, in 1980, the National Seed Company (ENS) replaced PNS and had the mandate to promote national seed production aiming at seed self-sufficiency and to coordinate seed development initiatives,

including the control of seed certification. ENS developed its own farms for seed production and established several seed processing plants across the country.

The National Seed Company (ENS) was, later in 1989, transformed into a commercial seed company and renamed as SEMOC. In 1998 SEMOC established a new venture with a Zimbabwean seed company (SEED Co) that currently owns 51% of the shares of the company. Presently, SEMOC/SEED Co is the largest private seed company that operates within the country. The company has shifted from their own production to contract out farmers to produce certified seeds and part of their needs in basic seed, the functions of varietal maintenance, pre-basic and basic seed production, processing, distribution and sale remaining their main duties. The company also has a network of seed retailers spread in many rural areas across the country. However, it is important to mention that SEMOC had a monopoly for many years and this combined with emergencies sales did not stimulate the company to get into the rural areas and engage in promotion activities.

PANNAR, a South African based company, is another important private seed company that from the year 2000 has continuously increased its intervention within the country. To build up farmers demand and access to improved varieties, PANNAR is currently engaged in the development of a retail network, seed distribution and sales, field demonstrations and partnership development with the public research and extension and with NGOs. There are also other private companies that have incorporated the function of distributing and selling seeds into their main agribusinesses, particularly of horticultural crops, the main companies being TECAP and AGRO-ALPHA, which also is a SEMOC/SEED Co representative in some of the areas that they operate.

Table 4.3 shows the amount of certified seed produced within the country from 1997 to 2000 by SEMOC. It can be seen that maize constitutes the major business of the seed industry, with rice in second place, the quantities of seeds produced from other crops being negligible. From the table, it can also be concluded that seed production of sorghum, wheat and cowpea have already been discarded from the production cycle of seed companies. The decrease in importance of seed production of most of these other crops could be related to their nature of autogamy (self-pollination), which does not stimulate the engagement of private companies in their production. The amount of maize seeds increased dramatically up to 1994 due to the demand generated by the emergency relief agencies involved in seed distribution after the civil war. Since then, most of the production and seed sales depend on orders placed after periods of natural disasters.

A rough estimate indicates that Mozambique needs around 80,000 tons of seeds per year to plant the current cultivated area, but improved seeds only represent around 5 to 10% of the total amount of seeds being used by farmers (Libombo and Uaiene, 1999). Table 4.4 shows the amount of seeds needed for some of the most common crops, taking into account the harvested area during cropping season 1999/2000. Averaged over the period from 1982 to 1998, the total of the expected seed production and imports is not sufficient to fully cover the total area planted with improved varieties.

Table 4.4 illustrates the high potential for the growth of the seed industry. However, one serious challenge for this growth is related to input market development, which is currently being undermined by inadequate agricultural output markets and high transaction costs in both input and output markets due to poor rural infrastructure, particularly roads. Seed companies are making important progress in order to develop and improve their efficiency and respond to the

market demands, which include the delivery of small packages of seeds, building and improving farmers demand and access to improved seeds through field demonstrations and development of a retailer network. As an example, Table 4.5 shows per province the current numbers of seed providers under SEMOC/SEEDCO.

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Despite these numbers, the present retailer network is still insufficient to guarantee an adequate coverage of the country with improved seed providers. For instance, Rohrbach et al, (2001) pointed out that in many districts within the country there is only one seed retailer to service a widespread number of farmers and around half of the districts are still to be reached by seed providers.

The private sector will take a long while (if ever) before there is an effective coverage of all the important agricultural districts with seed retailers that could provide farmers with improved seeds. It is also obvious that improved seeds play an important role to increase food production and yields. It is within this context that local seed production is an efficient and low cost alternative of providing farmers with improved seeds, particularly for self-pollinated crops, which are not generally of interest to the private sector. Local seed production is also a means of increasing farmers' awareness of the value of and demand for improved seeds. Due to the importance of local seed production in complementing the efforts of the private sector, the Government and several NGOs are involved in the promotion of this activity, particularly through community based organizations, but in many cases there is need to consider the sustainability of these interventions, particularly regarding subsidies, profitability and seed quality and market. There is a need to build up linkages between community seed producers with agricultural research institutions and seed companies for the supply of improved basic seeds and to effectively develop a market for seeds. There are already pilot experiments to introduce vouchers to replace the prevailing system of free seed distribution during periods of emergency. In addition, farmers should also be provided with relevant information and technology for seed production and thus, training of the front line extension workers is critical.

Table 4.3 Certified Seed Production in Mozambique (1979-2000)

Crop year	Maize	Rice	Sorghum	Wheat	Cowpea	Bean	Peanut	Sunflower	Total
1979	100	315	0	0	0	0	34	209	658
1980	252	137	2	0	17	0	33	121	562
1981	826	339	0	150	21	10	45	116	1507
1982	1244	3151	0	85	17	0	10	42	4549
1983	1423	1053	72	198	20	16	5	1	2788
1984	672	2984	143	152	26	21	5	62	4065
1985	576	3021	93	6	70	1	12	65	3844
1986	1013	3742	27	0	17	1	11	14	4825
1987	628	1900	29	13	0	0	18	10	2598
1988	281	1940	18	0	15	6	19	53	2332
1989	1236	3272	89	0	83	56	20	1	4757
1990	1691	3215	112	0	98	41	47	0	5204
1991	2091	2188	84	0	136	5	92	0	4596
1992	843	2338	63	0	91	15	80	0	3430
1993	2354	2819	153	0	286	50	49	0	5711
1994	4798	3456	14	0	322	91	25	0	8706
1995	3680	937	155	0	343	28	50	0	5193
1996	1238	1235	3.7	0	140	77.3	19.1	0	2713
1997	2151	154	0	0	144	43.9	26	8.3	2527
1998	427	285	0	0	0	4	0	1	717

Source: SEMOC annual reports.

Table 4.4 Estimates of the amount of improved seeds needed to cover the total Area Planted in the 1999/2000 cropping season

Crop	Harvested area (ha)	Seed rate (kg/ha)	Total seed needs (ton)	Rate of seed renewal	New seed needs/ year (ton)	Expected imports (ton)	Expected national production (ton)	Seed gap (ton)
Maize	900	20	18,000	3	6,000	2,800	1,600	1,600
Sorghum	390	12	4,680	3	1,560	700	100	760
Millet	75	12	900	3	300	200	0	100
Rice	135	80	10,800	5	2,160	0	2,200	-40
Cowpea	300	30	9,000	5	1,800	800	200	800
Peanut	210	40	8,400	5	1,680	900	100	680

Table 4.5 Number of seed retailers in each province, 2002

Provinces	Number of seed retailers
Maputo	22
Gaza	11
Inhambane	19
Sofala	48
Manica	42
Zambezia	41
Nampula/C.Delgado/Niassa	23
Total	206

2. Source of new varieties

There are several organizations that are involved in the selection of new crop varieties and they include INIA, Faculty of Agronomy at UEM, Seed companies (SEMOC/SEED Co, PANNAR) and NGOs, particularly World Vision, Food for the Hungry International and Care International. These organizations are mostly involved in variety selection through trials (on-farm and/or on station) where a set of crop varieties are compared in specific experiments with the main goal of testing their specific adaptation, reaction to diseases and other traits that are of importance to farmers.

The main source of varieties for these trials comes from IARCs, generally through the public research institutions, as has occurred, for instance, with pigeon pea, sesame and some varieties of peanut, which were delivered directly to NGOs from IARCs but this is not always the case. The main IARCs with regard of variety supply are as it is shown in Table 4.6.

INIA, Faculty of Agronomy and SEMOC generally carry out crop breeding activities. INIA develops its breeding programs on maize and cassava, while for all other crops (sorghum, millet, grain legumes, sweet potato, rice, cotton and cashew) the research agenda emphasis is selection of varieties developed at other research institutions. The maize breeding program emphasizes its activities on the development of open pollinated varieties and has also embarked on the development of Quality Protein Maize (QPM). The cassava-breeding program has just started and the major emphasis is on the development of new varieties that are resistant/tolerant to Brown Streak disease (which rots the root of the plant and is prevalent in coastal areas particularly in the North and Central parts of Mozambique). The Faculty of Agronomy develops breeding programs for peanut and sunflower with the financial support from the Italian Government. SEMOC has discontinued its rice-breeding program and currently has a very limited program on maize breeding.

Table 4.6 Research Centers that Provide Varieties for Testing and Selection

IRCs	Crops
CIMMYT (Zimbabwe/Mexico)	Maize
IITA (Nigeria/Ibadan)	Cassava, maize
ICRISAT (Zimbabwe/Bulawayo)	Sorghum, millet, peanut, beans, pigeon pea
CIP (Kenya)	Sweet potato
CIRAD	Cotton
IRRI (Philippines)	Rice
WARDA (Ivory Coast)	Rice
AVRDC	Horticulture crops

5. Soil Fertility Management

a. Major Soil Types and Characteristics

Mozambique presents a wide variability in terms of its physiographic, geological and climatic characteristics that give rise to a great diversity of soil types. Based on the FAO classification system shows that the prevailing soils of Mozambique (Figure 5.1) comprise: Arenosols (28%), Lixisols (23%), Leptosols (9%), Acrisols (8%), Ferralsols (7%), Fluvisols (6%) and Luvisols (5%). In the southern part of Mozambique and along the coastal strip (large part of Nampula and

C.Delgado) arenosols and luvisols prevail, which developed from a sedimentary basin. Basically, these soils are eolian deposits (coastal dunes) and old marine deposits, known as "Mananga". It consists of a sodic, saline subsoil layer covered by a sandy layer of variable depth, arenosols being those with a sandy layer deeper than one meter and luvisols being the reverse. Arenosols have poor soil fertility and a low holding water capacity, while luvisols present a medium soil texture and with low to medium soil fertility. Along the sedimentary basin, fluvisols also occur, which develop on alluvial and fluvial-marine zones, mainly along the valleys of Incomati, Lipompo, Save, and Zambezi Rivers. They comprise zones with deposits from river action or from the combined action of river and sea (estuaries), thus including floodplains, coastal plains, estuaries, lakes and alluvial fans at the foot of mountain slopes.

Most soils north of the Save River derive from acid rocks, rich in quartz (granites and gneisses) and their classification comprise lixisols, ferralsols, acrisols and nitosols. These soils have a low fertility, high capacity for phosphate fixation and good physical characteristics.
In the volcanic rock zone, along the Libombos chain and Eastern part of Manica province, the prevailing soils are leptosols, chernozems and vertisols. These soils are deep, red, brown and black, well to poorly drained, medium to heavy textured with low to medium fertility.

Table 5.1 shows several chemical characteristics of the soils of Mozambique. Most soils present low to medium fertility, particularly for arenosols and ferrasols. While fluvisols show high soil fertility, acrisols, lixisols, and luvisols could be classified as having intermediate soil fertility with high levels of P and K uptake. In general, there is adequate content of exchange potassium.

b. Soil fertility situation and research in Mozambique

For smallholders in Mozambique, crop production and yields still remain considerably below potential. For example, yield of maize, a basic staple food, was only 0.6, 0.7 and 0.9 t/ha in the 93/94, 94/95 and 95/96 cropping seasons respectively. One of the most serious consequences of low crop yields is that the country's objective of food security remains unaccomplished and the country is highly dependent on food imports, in spite of high agricultural potential. Thus, food self-sufficiency and food security remain as major goals of the current government strategy.

Inadequate soil fertility is one of the major biophysical crop production and yield constraints in Mozambique. As in many tropical countries, the relatively high temperatures, high amount and intensity of rainfall that prevail in the greatest portion of the country, namely in the central and northern parts, cause high rates of weathering and soil organic matter decomposition processes. These result in soils of low nutrient reserves, low organic matter content and low cation exchange capacity and with relatively high susceptibility to erosion. These characteristics are, with few exceptions, exacerbated in the southern part of the country where soils are generally of a sandy type with an inherent low fertility and low water holding capacity.

Crop management also contributes to soil fertility depletion, as there is usually an inadequate replenishment of the soil nutrients that are removed when crops are harvested, leading to a decrease in agricultural production per capita and thus, to an increase in food insecurity. To substantiate this, a study was carried out at INIA and shows considerable losses of soil nutrients on a yearly basis of 34.1 kg/ha for N, 6.1 kg/ha for P_2O_5 and 24.6 kg/ha for K_2O when cultivated and non-cultivated lands were averaged together. Further, the study shows that losses are higher in cultivated lands located in areas with annual rainfall exceeding 1,000 mm and with high risk of soil erosion. The study revealed that under these conditions, annual losses in soil nutrients

might be as high as 122 kg/ha for N, 27 kg/ha for P_2O_5 and 97 kg/ha for K_2O. As shown in Figure 4.1, soil fertility decline is more acute in the more densely populated areas in the provinces of Cabo Delgado, Nampula, Zambézia, Manica and in the Coastal belt of Southern Mozambique where the pressure on agricultural land is increasingly reducing the traditional fallow period, a practice that farmers generally use to restore soil fertility. Despite the continuous decline in soil fertility, there is little incentive for farmers to invest in technologies that reverse the current status of low agriculture production and yields. Several factors contribute to this lack of incentives, such as thin input and output markets, and lack of access to credit, but in this section emphasis will be given to technology and information.

Table 5.1 Average Chemical Characteristics in the Uppermost Layer of Major Soils in Mozambique

FAO class	CEC	K	P-Olsen	pH-water	OC	Total N	Clay
	Meq/100 g soil		ppm			%	
Arenosols	5.0	0.3	10.0	6.1	0.7	0.07	8.0
Ferralsols	7.2	0.4	7.0	5.6	0.9	0.09	18.0
Acrisols	13.5	1.0	36.0	5.8	1.7	0.11	25.0
Leptosols	14.0	1.8	4.0	6.5	1.7	0.13	25.0
Lixisols	15.9	0.5	20.0	6.3	1.8	0.16	24.0
Luvisols	11.7	0.8	28.0	6.6	1.2	0.10	22.0
Fluvisols	24.8	0.8	51.0	6.6	2.2	0.12	36.0

The present soil fertility research effort is mainly geared to address the problems that smallholders face, taking into account their investment capabilities. The strategy is based on the notion that, to achieve a sustainable crop yield, all available sources of nutrients, both inorganic and organic, should be fully exploited and tailored to fit into the prevailing farming systems. Together with yield increase, sound soil fertility management should also minimize soil erosion and soil nutrient losses.

Overall objective of the soil fertility management and conservation program under INIA is to develop sound soil fertility management practices that lead to sustainable crop yield of the small holding farmers while preventing soil degradation. The specific objectives are:

- To characterize and classify the soil fertility status of the country.
- To identify, test and recommend those cropping practices that mobilize and allow the use of locally available and renewable sources of nutrients.
- To adjust and fine-tune the current inorganic fertilizer recommendations, considering the natural environmental and socio-economic circumstances of the farmers.
- To establish a data base on soil fertility research

The main activities are:

- Study on organic fertilization based on bat guano. There are several caves with bat guano in southern Provinces of Gaza and Inhambane.
- Intercropping and crop rotation studies including improved fallow with green manure cover crops (pigeon pea, lab-lab and cowpea)
- Study on inorganic fertilizer to adjust the current blanket recommendations
- Study of the interaction between organic and inorganic fertilization

In addition to these activities, the program is also collaborating with ICRAF in order to use agro-forestry species to build and improve soil fertility status. The program will take advantage

of the research findings available within the region. Similarly, INIA has just joined the Soil Fertility Network in the SADC region, involving Malawi, Zimbabwe and Zambia, and steps have already being taken regarding co-ordination and joint planning for soil fertility research.

c. Technology and Information

There is limited impact and uptake by farmers of technologies that research and extension recommend for the maintenance and improvement of soil fertility aiming at increasing crop production and yields in a sustainable manner. The technology domains currently being recommended are of two types. One domain emphasizes low input agriculture in which the soil resource base is maintained through the use of organic compounds and other low cost practices that promote soil water and fertility conservation and avoids soil degradation through erosion. The other domain promotes agricultural intensification, particularly through the use of inorganic fertilizer, which is considered the key element for sustainable agricultural production, productivity and conservation of the natural resource base. However, one missing element is that no emphasis is being given to an integrated strategy embracing these two approaches, which so far, are being implicitly considered as independent technology domains.

1. Low input agriculture

Although the use of organic matter per se has the potential to decrease soil infertility, its sole use is often insufficient to fully replenish and provide the quantities of different nutrients required by crops, particularly in many areas where crop residues and other sources of organic compounds are not yet being incorporated to the soil. On the other hand, the use of nitrogen-fixing species is showing an enormous prospect for improving soil fertility and yields, particularly in a maize-based farming system in neighboring countries, such as Malawi and Zambia, where results from agro-forestry research are now being scaled up and out to the farmers. In order to promote such technologies, Mozambique has recently joined with Zimbabwe, Zambia and Malawi in the regional initiative for agro-forestry development in the Zambezi River Basin funded by the Canadian International Development Agency. Similarly, together with Malawi and Zambia, Mozambique recently became part of a USAID-funded project, with the goal of enhancing impact and scaling up agro-forestry experiences, targeting people of the participating countries that share a common language (Chichewa/Nyanja) and culture. Both projects operate in Tete province and are being technically implemented through the ICRAF´s office at INIA´s headquarters. Apart from these projects, there is still need for Mozambique to develop new and to adapt agro-forestry technologies developed elsewhere, with the goal of reaching different farming systems for different agro-ecological regions.

2. Agriculture intensification

Although, there is a growing perception that agricultural intensification could substantially contribute to reverse and avoid soil depletion and promote sustainable crop production and food security, its use is still very limited within the country. It is mostly confined to places where farmers obtain support on credit from projects, the main ones being the SG2000 and the Special Program for Food Security from FAO, both of which aim to promote technologies and identify constraints that hamper the use of improved technologies, particularly inorganic fertilizer. However, even with support on credit and access to inorganic fertilizers, farmers tend to invest this fertilizer on crops with an outlet market and that are profitable, showing intrinsic links between fertilizer use and the output market. In addition, there is still a huge gap between the

rates of fertilizer recommended and those that farmers apply, bringing into question the appropriateness of those recommendations. There are also variations among farmers not only in terms of the crop response they obtain from the applied fertilizer, but also in terms of the fertilizer affordability, showing the importance of socio-economic studies. These gaps indicate the need for further research and simulation analysis aiming not only to fine-tune the current blanket fertilizer recommendation across agro-ecological regions, but also to provide options that take into account socio/economic challenges that farmers face.

6. Input and Output Markets

a. Input and output market systems relevant for the major crops

The highly dispersed rural population relies heavily on their own production for their consumption needs, and only about 30% participate in output markets, and less than 7% use purchased inputs. There are several characteristics of the Mozambican markets that result in low participation rates.

Both input and output markets are strongly affected by Mozambican geography and infrastructure. Surplus agricultural production is in the north, food deficits are in the south. There are three main transport routes, designed to go east-west along three main corridors (Maputo, Beira, and Nacala) and not designed to transport goods from north to south or vice-versa. Maritime transport is very expensive and so agricultural goods flow north to south by this route only if a ship is looking for return cargo to cover minimal costs, after bringing higher value consumer or industrial goods to the northern markets. As was noted in a recent MADER study, the center zone of the country does supply substantial amounts of maize and other products to Maputo and the rest of the south, but the floods of 1999/2000 demonstrated the fragility of that trade, dependent upon a limited road transport system that was flooded (Abdula, 2001).

Stated simply, 'Mozambique does not have a well-developed agricultural commercial sector" (MADER, 2001, p.2, author's translation). Few rural trading markets have developed in Mozambique, where producers and traders might congregate to buy and sell (Santos et al., 2002). The larger towns all have market places, many arising from originally illegal informal trade places, as with the SIMA covered markets in Maputo, and some formal market places established through local government. There are periodic rural markets or "ferias" in Zambezia Province and elsewhere in Mozambique (DNC/MIC, 2001).

Input markets are characterized by high costs, low volume and little credit. They are used mainly for cash crops linked to large-scale private firms. The abandonment and destruction of the rural trading stores at the time of Independence and during the civil war means that there are few potential rural outlets for inputs. In addition, rural traders are not always willing to take the risks of stocking materials with low turnover rates or uncertain markets. In the major cities, such as Maputo and Nampula, there are retail and wholesale input outlets for the commercial firms, but the smaller retail outlets of the parastatal Boror were closed when it was nationalized and SEMOC has not retained many of its retail stores. There are NGO and MADER/DNER projects, including those with SG2000, that seek to increase productivity through input use. While inputs are arranged by the NGO for the farmer associations to the farmers, the negotiations between the private sector and the NGOs are helping to develop local supply channels by reducing transaction costs and risks for the private company. Without NGO

projects and their work with farmer associations, inputs are not easily available to farmers, hindering adoption. Local agro-chemical companies and agricultural supply houses are based in the main cities, so individual farmer contact is limited. The objective is for farmer associations to negotiate directly with the private sector, but in many places, the NGO presence is still critical.

Focusing on agro-chemicals, most of the fertilizer is currently used on a range of cash crops, particularly for the large-scale commercial farming, and that is where the highest potential for fast growth occurs. Pesticides are primarily used on cotton. Various arrangements are being used to coordinate the input and output markets to encourage the use of inputs such that the quality and quantity of the output is sufficient for market sales, as with cotton, tobacco, paprika, and some of the oilseeds. The most common arrangement is for the commercial firm to arrange input purchases through the private sector dealers and then the firm works with contracted farmers in production, using outgrowers or farmers associations to distribute the inputs on credit to smallholders, as with cotton. Plantation agriculture also uses agro-chemicals, commissioning the inputs through the delegated importers, obtaining through the KRII program, or importing themselves. Commercial imports of un-committed agro-chemicals for retail sales are very limited.

As mentioned earlier, a small amount of fertilizer and improved seed is used by the family sector for food crops including maize and rice, mostly under special technology programs, including SG2000 and the Special Program for Food Security (SPFS) of the FAO, using KRII supplies or working with local agrochemical companies Agroquimicos and Agrivet. Since 1986, the Japanese government KRII program has been the major source of fertilizers and pesticides for the private sector in Mozambique. In addition to special public sector programs through extension, the large-scale producers and processors have taken advantage of this source of inputs in the past for cotton and other crops, but as was mentioned earlier, the program for fertilizers and other agricultural inputs may be on its way out.

Given the lack of retail market access and credit, NGOs and farmer associations are working to help provide inputs and technology to smallholders through private-public partnerships. CLUSA and CARE, for example, have coordinated fertilizers and seeds for selected crops in the zones where they work, enabling contracts between the private sector seed and agro-chemical firms and the farmer associations. They have also worked to develop the contract farming relationships, recognizing that the sustainability of the system is greater, as the firm arranges inputs. With weak contract enforcement in agriculture, the third party role facilitating contracts is critical and has been successful in various cases. In spite of all the efforts, some of which will be detailed below, as a recent presentation states, “input supply systems remain weak” (CARE 2002).

The seed subsector is quite different in structure from the agro-chemical inputs. Whereas all chemical inputs are imported, seed comes from a variety sources, including imports and local commercial sources, INIA and other governmental sources, as well as through non-market sources. As indicated in Figures 2.12 a-k, for the cropping year 1995/96, the majority of seeds used by farmers are from non-market sources, either from retained own seed or from neighbors. Cotton is an exception, with supplies coming from processors through outgrowers. Many farmers obtained millet seed from emergency aid programs.

The supplies of marketed seeds may be from contracted commercial imports or from local multiplication by the seed company, by contracted large private farms or, increasingly, by contracted farmer associations, with NGO assistance. Currently farmer associations and research stations are under contract for the commercial companies, including SEMOC and PANNAR, for local multiplication of sunflower seeds and others. The lack of breeder and foundation seed supplies is affecting multiplication, regardless of who is responsible for it, and that is one reason for the needed NGO participation, with their wider contacts and financial pull. There have been quality problems (low germination, lack of purity) recently with seeds from the farmer association multiplication efforts, so the seed companies are concerned about more supervision and inspection. The seed companies pay for the inspection services of SNS to certify the seeds for commercial sale, but with the dispersed production by smallholders, SNS staff finds it difficult to give adequate supervision.

Local multiplication for noncommercial use is one way to ensure supplies for small farmers in more remote areas, but ensuring quality remains an important issue. NGOs help to facilitate the farmers associations in this work through technical training and coordination efforts with the seed companies (Bingen et al 2000, CARE 2002, Africare 2002). Generally there is little development of direct retail sales of seeds by farmer associations, and the associations do not receive the business training that would be needed, for training is focused on the technical seed production side.

For the semi-subsistence crops and in very remote areas, combined efforts of the public sector and NGOs as well as international centers have enabled farmers to have access to new seed on a limited basis. Often these are areas where previous disasters (floods, drought) have occurred and farmers are accustomed to receiving seeds free of charge, so there is no custom of purchasing seeds, nor do there tend to be market outlets for the product to generate the income to pay for seeds. In areas of low potential or crops with little commercial seed involvement, these community level efforts at seed multiplication and distribution are critical. Strategies here may focus on developing one farmer who specializes partially as a multiplier.

Even in areas with greater market activity, for cassava, sweet potatoes, and other basic consumption items, commercial incentives have not proven sufficient for strong private participation and are unlikely with the vegetatively propagated crops in Mozambique for the present. There has been extensive collaboration between public sector research and extension with NGOs and farmers associations or community groups that has enabled new varieties to be distributed to respond to the disease problems in cassava and new varieties of sweet potatoes, but insufficient stocks and the need for further research are limiting the ability to respond (Howard, 2001). In addition, NGOs form the main link between research and farmers, so while new varieties arrive for propagation when the NGOs are present, the flow is cut after NGOs withdraw, unless extension and research are directly linked with the farmers. The marketability of the material may not be high, but with the nutritional improvements to be gained with new cassava and sweet potato varieties, there is justification for public sector investments.

Output marketing has changed dramatically since the colonial years and the years of socialism in the 1980s, when the government was very active in the markets and in controlling markets. In colonial days, there were strong geographical concessions, such that only one buyer for commodities was present and that buyer set the price. The same was true for sales of inputs. Under socialism, state control over marketing with fixed minimum prices also meant a single price, and no negotiations. Rural stores were the focus of trade. These were all but destroyed at

independence (exodus of traders) and in the civil war (attacks on the physical infrastructure). Now, the government is seeking ways to get the private sector active throughout the rural areas. For the most part Mozambique has changed the role of the government to be that of a facilitator, with investments in market information, transport and communication infrastructure, and a legal framework for trade.

For agricultural outputs, in many surplus zones during the harvest season, it is common to see informal traders on the side of the road, waiting for producers to bring their products to the roadside for sales. Word of mouth in the community lets everyone know that there is a trader, and farmers headload and bring their products by bicycle to sell. The most common commodity traded is maize, but in groundnut and bean production zones, the markets function in a similar way. These informal traders move from place to place looking for products, a costly process, resulting in a hit-or-miss type of trading system, relying on whatever transport is available. To sell, these traders either go to wholesale market areas in the large cities, or to formal sector traders or their representatives. Formal traders regard these "ambulantes" (itinerant traders) negatively, as the ambulantes have no investment in the system and avoid taxes and other regulations. The importance of the ambulantes in getting products out of rural areas cannot be ignored, however.

As was found in district research from 1996 – 1999, many areas of the country do not have good, regular access to agricultural inputs and consumer goods (Figure 6.1) nor is there adequate ability to get agricultural products out of the zone (Figure 2.7). Clearly in Niassa and parts of western Nampula, roads and markets are not able to meet needs. With few market opportunities and limited availability of consumer goods in that region, farmers wanted Malawian traders to have access to Mozambican markets because they brought consumer goods and implements to trade for maize and other products (Whiteside 2002 and SIMA, 2002b).

Since 1992, NGOs have become an important link between formal traders and farmers. Agricultural programs to increase output have been found to be unsuccessful due to the lack of markets, so NGOs have determined the need to help develop market opportunities, reducing the transactions costs for the traders, while working to enhance the skills of farmers in the new market environment. NGO staff contact traders, identify potential crops and zones for marketing, and then coordinate with farmers to have stocks ready for traders; they may even negotiate prices and conditions, sometimes arranging transport for the commodities.

There is very little large-scale agriculture, a possible disadvantage and a possible advantage in market development (MADER 2001). Large-scale agriculture might provide an operational basis for agricultural supply houses, which could make inputs also available for the small-scale, but there is no large-scale incentive for such commercial investments. On the positive side, there are not the conflicts found elsewhere and nor is there overwhelming market control by a small proportion of producers. There are cases of monopsony traders, as with the concessionaires for tobacco and cotton, where negotiations between industry and government are needed for marketing decisions. Recent investments in plantation agriculture for tea and sugarcane indicate that there may be growth in this sector.

Many of the basic food crops are not frequently marketed, or are only important in a specific region, and so are not included in the Market Information System (SIMA). Sorghum and millet are not and a look at Table 2.7 shows that few households participate in sales of these commodities. There are sales of alcoholic beverages made from sorghum and other grains,

however these are local, non-industrial sales, providing informal sector income to households. With cassava, fresh cassava is the most frequently found commodity on the market, with dried cassava (in large chunks) occasionally available, but cassava chips, flour, or processed goods (such as breads) are rare. Most cassava is marketed through the informal sector or households simply selling their own production. When the prices for maize are high, there is the perception that cassava marketing increases, particularly for dry cassava (MIC bulletin 43/44), and recent work shows that farmers do tend to rely on cassava when their maize runs out in the northern zones (Santos, et al. 2001), although recent market research did not find dry cassava in some important markets in the north at all (SIMA, 2002c). Farmers may be consuming more cassava, not necessarily selling more cassava. With the sales of cassava chippers through World Vision by AgroAlpha, there is an expectation that more cassava chips will begin to be seen in the markets, but so far market enumerators have not noted an increase.

In the oilseeds sector, NGOs have imported small scale ram presses which are sold to local entrepreneurs, and then a range of extension and market efforts are used to ensure supply of sunflowers and sesame for processing, to help development the output market for locally produced oil (Gordon and Langworthy, 1999). There is also an industrial oil-processing sector, but much of that relies on imported crude oils through PL480 programs and commercial imports, which compete with domestic oils when they reach the markets. In the north and center, inexpensive Asian palm oil provides the competition, whereas in the south imported South African sunflower oils keep the prices low. Cottonseed is the source for oils for some parts of the industry. There are also increasing opportunities to sell sunflowers and other oilseeds for domestic industry in the north. Agents for domestic industry may go to high production regions to purchase sunflower and other seeds for edible oil processing. Because of the high transport costs, oil can be very expensive by the time it reaches markets or retail shops. In addition, consumers tend to purchase oil in small quantities, less than one liter, often in small jars or even bottle caps. In areas far from the urban markets, small ram presses have made it possible to supply oil to rural populations much more cheaply, but the rural demand remains weak.

In addition to maize, groundnuts and beans are two food crops with fairly stable consumer market demand in Mozambique and in the region. Formal and informal traders will buy these crops for selling in the cities. Recent demand for the small Spanish style peanuts has created heavy pressure on seed supplies, and this is clearly a crop that will sell, if farmers have the right variety.

Markets for locally produced rice in Mozambique are not well established, with less than 20% of production entering the market (Alasia, Low, and Soregaroli, 2001). With liberalization and growth, commercial rice imports from Asia enter the urban markets of the south. Rice produced under irrigation is sold to the local processing industry and is found in urban markets. However, farmers in Zambezia, where 47% of domestic rice is produced, consume rather than sell their rice and rice processing is limited. As with other crops, there are no quality standards for local rice developed in the market, and so no premiums are found for aromatic and other types of rice.

Cashews have been a major cash crop for many farmers for decades, as Mozambique was the leading world exporter of cashew nuts in the 1960s (Wandschneider and Garrido-Mirapeix, 1999). The trading systems were based on the rural stores and large rural traders in provincial capitals, who had the processing facilities and the export links for the Asian and other markets. Under socialism, government control of marketing resulted in low controlled producer prices and controls on the export of raw cashews, limiting the market. Cashew markets are now

liberalized, but there are continued problems (Mole 2001). About 42% of farm households have cashew trees and harvest cashews, but only about 17% of households sell part of their production (Table 2.7). Informal marketing of raw and home processed cashews is common in the south, where it is a source of cash income, but most of the southern production still goes for home consumption. In the north, particularly in Nampula, the private sector large and small traders actively purchase from producers. As with other crops, there are no price differentials for quality in the cashew markets, although traders indicate that they seek quality by buying in areas where the quality is higher (Wandschneider and Garrido-Mirapeix, 1999). As a result, export prices for Mozambican cashew nuts are relatively low compared to neighboring countries and producer prices stay correspondingly low.

1. Private sector involvement in input and output markets

As can be seen from the above description, the private sector in Mozambique is heterogeneous, with some of the traders from colonial days and new entrepreneurs coming in to challenge them, informal and formal sector traders competing for the main commodities of maize, beans, and groundnuts. The long time traders were accustomed to government controls on markets and to regional monopsony, where they could operate knowing the conditions. They have their informal systems for communication and trade, based on family and ethnic ties. The new entrepreneurs come from a market economy background and tend to look for new crops, new opportunities, and compete with the large trading houses. Both the long-time traders and the new entrepreneurs are challenged by the informal trading system that developed towards the end of the civil war and was responsible for much of the domestic agricultural marketing for a period after the war. In 1994 market research, it was frequent to enter a production zone and not find a single trader, with district officials lamenting the presence of surplus maize and other commodities and yet no one to buy, even along the main Nacala Corridor. In 2002, market research found no such problem along the main routes, but rather in the interior (SIMA, 2002a). As transport improves and trader competition continues to develop, the interior will see more marketing opportunities, both formal and informal sector, at least for buying outputs.

The input side shows weaker private development due to a variety of reasons. The KRII program of importation has been a disincentive for private importation of commodities (Howard, Soares and Low, 2000). Private agro-chemical companies work with large firms to supply imported inputs, but for smallholders the retail outlets are few and far between. Traders lack the knowledge about the use and stock management of agricultural inputs, but that may be less of a constraint than the problems with the demand side and low volumes, with little agricultural production credit to facilitate purchase by smallholders. The demand side for inputs will grow stronger as the output markets improve, as long as farmers gain more experience with the use and value of the inputs.

With relative stability since the Peace Accords, the private sector is beginning to invest in agro-processing and production, as indicated by the investments in the database developed by Benfica (2002). When working with small-scale farmers, they have learned that NGOs and farmer associations may be the effective way to get around the contract enforcement problems, so private sector such as AGRIMO and SANAM look to NGOs for assistance. Major investments in plantation agriculture in tea in Zambezia and sugarcane and maize in the south help boost overall agricultural production, although Benfica posits that their contributions to poverty

alleviation may be limited to hired laborers and limited linkages with the local economies (Benfica, 2002).[18]

There is limited domestic capacity for technology generation in agro-industry in Mozambique. AgroAlpha is one of the private firms manufacturing agro-processing implements, both small and medium scale. They have developed cassava chippers and oil presses, using machinery from other countries and adapting to Mozambique, and work with NGOs for part of their diffusion efforts. AgroAlpha is also involved in seeds and implements, as a wholesaler and retailer in the main production areas. Based in Maputo, they have retail space in Nampula; in Quelimane they have a representative and they expect to open a store in Manica soon. They have worked with partners. For example, they are associated with a church group in Gaza and worked with CARE in Nampula on seed multiplication efforts, as well as processing machinery. One of the gaps identified was the completion of feasibility studies on technologies to make sure that all will see profits. For instance, there is a medium scale rice mill available, but it turns out that the optimal volume cannot be met to make the machine profitable.

2. Extent and efficiency of roles played by public and parastatal institutions

The recently developed Agricultural Commercialization Strategy, approved by the Council of Ministers in 2001, indicates the following roles for the government: 1) create a favorable environment for domestic and foreign investment in agricultural markets; 2) facilitate investments through improved infrastructure and research and information, particularly for nontraditional exports; and 3) promote and support the participation of family sector agriculture in markets, to gain more value added (Council of Ministers, 2001, p. 3). The strategy posits what the government should be doing to promote agricultural markets, not what it is doing. Pieces of the strategy have been done by government with donors (road investments, for example) and other aspects are being handled on a piecemeal basis by NGOs, promoting input and output markets, although on a limited and geographically focused basis in each case.

Contract enforcement fits into the category of "favorable environment", although it is not explicitly included in the strategy document. As noted in various reports, contract enforcement is basically non-existent in rural areas of Mozambique. That is why the private cotton companies have lobbied for geographic monopsony rights in concessions, as it is one of the only ways to ensure that farmers in a zone sell them their cotton and the firm can recover the development costs, the input credits, and have sufficient cotton to generate revenues from the mill. Fundamental in the argument is the lack of contract enforcement. Contract farming arrangements now are done through farmer associations with NGO collaboration so that peer pressure and association benefits can be used to ensure repayment of debts and marketing of products through the contract. In a country with limited transport and communications, it is hard to enforce the legal system. Since farmers do not have ownership of land, it cannot be used as collateral and the agricultural credit system will only be available to those with some substantial collateral to offer.

Another function not included in the Agricultural Marketing Strategy document is the issue of grades and standards. A recent report evaluated the status and needs for grades and standards in

[18] With research in Chokwe, Cramer and Pontara (1998) develop arguments that the development of a rural proletariat working with commercial agriculture could help to alleviate poverty, particularly for female-headed and female- dominated households. Tsschirley and Benfica (2000) suggest that contract farming alternatives may provide better poverty alleviation than agricultural labor on large commercial farms.

Mozambique (Bawden, Kerallah, and Mainville, 2001), particularly as related to agriculture and fisheries. The government set up The National Institute for Standards and Quality (INNOQ) in 1993 for standardization, certification, accreditation, quality control and metrology. INNOQ has developed only five standards for the agricultural sector: maize, maize flour, wheat, wheat flour, and iodised salt. With insufficient funding and personnel, even these standards are often disregarded. In the end, it is international standards that are used and export companies take measures to ensure the quality of their export, so that they do not lose their market.

There are certain subsectors in the economy that would benefit from grades and standards, particularly but not solely export commodities. For that the government would need to promote subsector organization around specific crops, and then get industry, traders, producers, and extension organized around the needed grades and standards, especially relevant for export commodities (Bawden, Kerallah and Mainville, 2001). The Zambia-Malawi-Mozambique growth triangle is seen as a major area for development of coherent policies that would facilitate greater trade and export market competitiveness, but currently there is no consistency. SADC guidelines for some commodities would need to link in inputs to achieving quality standards and currently this is an area with problems. The report focused on cotton, cashew, and shrimp as commodities that could most benefit from established and enforced grades and standards. The authors do note that this is an area considered of much lesser importance than improving productivity and availability of inputs and markets for outputs (Bawden, Kerallah and Mainville, 2001). While markets may be expanded with higher quality, it is not certain that this is a critical area for investment when there are so many other constraints in the system.

In a related issue, as has been noted, there are almost no price premiums in Mozambique for a commodity of quality. For example, sunflower oil, a preferred product, does not retain a premium. Maize prices in rural markets are undifferentiated by quality, with only extremely bad quality maize receiving a lower price. The role for quality protein maize in the market is minimal unless some pricing system and market segmentation develop. FAO advisors have recognized this as a constraint, limiting the adoption of purchased seeds and other inputs for farmers do not have the incentive to improve the quality in their production. With paprika, this may already be causing problems for the young industry, as farmers are penalized for poor quality, and this discipline in a new element in the markets. Production and marketing extension will need to be combined with market mechanisms, so that farmers have the incentive and the knowledge to produce high quality commodities.

Regarding land tenure, a new land law was enacted in 1997, with various additional annexes and policy statements. It seeks to define land use rights, while maintaining the principal of state ownership of land. The law recognizes traditional land uses and grants smallholders use rights based on occupation, however, these use rights are tradable with difficulty, and are currently not accepted as collateral by financial institutions. The law seeks to formalize the role of local communities in land decisions, but that may not result in equity distribution, given existing inequalities in distribution at the local level (Jayne, et al., 2001). There are still many hurdles to implementing the law, due to lack of knowledge and training on the law at local administrative levels, where decisions will be made and registered, among other difficulties (FAO 2002). Where off-farm income earning opportunities are scarce, as in Mozambique, lack of land access is associated with lowered income, as was demonstrated by Jayne and others (Jayne et al., 2001), as well as by the MADER team (MADER, 2001). So the poor are poor in land as well as income.

3. Status and effectiveness of other rural service institutions

The rural credit system was described in these terms in a recent proposal for a cooperative bank:

> "There is no institutional structure that provides rural finance in Mozambique. There are a number of funds that provide a specific financial product to a selected target group of rural entrepreneurs, while some small-scale rudimentary micro-credit initiatives for the rural areas are in their establishment phase. All these initiatives are strongly subsidy dependent, their impact is very small and long-term sustainability is questionable." (van Empel, 2001, p.18)

While being a rather pessimistic assessment of rural finance, the above quote summarizes the basic limitations of rural finance in Mozambique. There are various non-bank financial institutions providing services in the rural areas, but they are usually limited in scope and based upon administrative subsidies Chidzero et al., 1998). Liberalization of the banking sector basically meant a withdrawal of lending facilities from rural areas as the risks and costs were too high (Ribeiro and Cuellar, 1999). There were two state owned banks in the early 1990s: Banco Comercial de Moçambique (BCM) and Banco Popular de Desenvolvimento. BCM was privatized in 1996 and BPD was privatized in e-named Banco Austral, with the state retaining 40% shares in the bank. BPD was heavily involved in subsidized agricultural lending and its successor, Banco Austral, did have a special agricultural fund, but with new stricter credit guidelines, agricultural lending has been limited. High rates of defaults and limited legal recourse have resulted in limited loan amounts to large private firms with collateral (MADER, 2001).

One of the current non-bank agents in rural lending is GAPI (Gabinete de Consultoria e Apoio a Pequena Indústria), originally established in the mid-1980s as a project and later transformed into a legally recognized financial intermediary under joint stock ownership, with private owners, Ministry of Finance and Planning, and the Freidrich Ebert Foundation (GAPI, 2002). GAPI credit funds are loaned to firms, cooperatives, individuals, or other institutions, and are relatively short-term loans at market interest rates (currently 3% per month in most cases). By their estimation, they have loaned approximately US$15.5 million, of which US$3.2 million went to agriculture and US$1 million to rural trade. Food processing industries were loaned another US$3 million.

GAPI funds have been lent for purchasing small and medium scale processing equipment for oilseeds and pulses. In Sofala, they have lent funds for fisheries and conducted training for ex-railroad personnel to become re-trained for new careers. They have also worked with farmer associations and NGOs to fund seed multiplication projects, where the NGO, in one case CARE, guarantees the market for the seeds when they become available. GAPI collaboration with CARE and CLUSA has enabled GAPI to rely on the technical expertise of other agencies, focusing on credit administration, which is considered their strength. In Nampula, Sofala, and Manica, GAPI is working with Technoserve on development of the oilseeds production and processing. Technoserve provides the technical assistance while GAPI provides credit and financial monitoring. In Zambezia, GAPI has worked with a cotton company, AGRIMO, to provide marketing credit, based on the guaranteed product market for the cotton. In the case of UCASNI, with legal recognition and assets, the Union received loans funds that are being granted to individual associations. In the south, GAPI has worked with the UGC to fund small-scale poultry production and ration manufacturing; UGC identifies the families and assumes part

of the risk, while providing technical assistance on poultry production. GAPI has also lent funds to local microfinance institutions, which use these to offer micro-credits. The development of rural savings receives funding from the Dutch government and others in a program with CARE. GAPI started in 2000 to use venture capital with medium scale enterprises, a new endeavor.

New efforts by GAPI in the north focus on marketing credit (for facilitating trading) rather than seasonal agricultural credit, for the former has been less risky and turn over faster (personal communication, Miranda 2002). These marketing credits to farmers associations are based on solidarity guarantees, with association fora (groups of associations) that are legally recognized, but with technical and organizational support of CLUSA and other NGOs. GAPI has taken on special funding for agricultural programs, as with the ADIPSA program, which is being developed initially in Manica province for both commercial and family sector agricultural loans. While GAPI is relatively small, it has established a reputation for low loan defaults (except in the areas affected by the 1999/2000 floods), and is experimenting with different types of credit lines for a range of rural activities. Retaining the low defaults through periods of institutional growth will be a challenge.

IFAD launched a large project, called the Agricultural Market Support Program (Programa de Apoio aos Mercados Agricolas). A similar project is being implemented in Zambia, called SHEMP. One aspect may be marketing and stocking credits, but experience from Zambia indicates difficulties with implementing the credits, so it remains to be evaluated. AMODER and GAPI are potential candidates for the credit work using PAMA resources, but this is an area that is still under consideration at PAMA.

There is a project on micro finance located in DNDR, with support from ILO, PNUD, and an AfDB project called AMINA. The role of the project is not to manage funds directly, but rather train and assist micro finance projects. They have contracted out the MicroStart program for urban and peri-urban areas and have begun funding some existing institutions recently, with ICI managing the project. They are developing a program of capacity building for decision makers, including staff from Bank of Mozambique, Ministry of Planning and Finance, DNDR/MADER, and UEM. The United Nations' Capital Development Fund Special Unit for Microfinance is providing technical assistance to the development of a Microfinancing Facility to be established with Canadian funds. In general, the microfinancing institutions are not involved in agricultural credit for the credits are usually very short term for a fast turnover, although the potential of micro finance in marketing credit is one option (INDER 1999). In most cases, there is no requirement for the borrower to state the use of the credit, and credits begin around $100, reaching no more than $1000. A recent effort is the community bank in Angonia, based upon the Proagria project that ended. With about 1 billion meticais (about US$42,000) in initial capital, the bank will be launched in July 2002 and followed as an experience of an independent rural bank. The DNDR staff will be provided training and technical advice to this basically microfinancing bank.

AMODER is another credit institution in Mozambique, with a base office in Maputo. The majority of stockholders are ex-workers from the government's marketing agency AGRICOM, eliminated in the late 1990s. They began working with used clothing sales, but gradually developed loan funds. The credit program was unsuccessful in Zambezia, but with EC funding, has developed a successful program in Cuamba in Niassa. It has just begun operations in Nampula Province. Typically it has not lent for agricultural production, but has been involved in other rural lending. In principal, they lend to individuals for rural store stocking and for small

scale processing equipment. Large-scale processors can go to the commercial banks, so AMODER tries to fill in the gap for smaller credits. They rely on legal documentation and collateral, and acknowledge that it limits the possibility for most farmer associations to obtain credit. They have been approached by the European Commission to begin working with farmer associations, but still require legal recognition of the association.

CRESCE is a Microfinance program of CARE working in Sofala, Manica, and Zambezia, and there are similar programs in Nampula and Inhambane. These programs have been developed to respond to the needs of urban and rural households for small credits to develop income-earning opportunities. The programs in Nampula and Inhambane focus on women's groups, but women are involved in all the programs, with 38% of CRESCE clients, being women (Wentling, personal communication, 2002). Small credits are given for trading and other activities with rapid turnover, and financial management and other training is provided to the savings groups. Income generating plans are developed to evaluate options, and the animators receive training. Nutritional training is part of the process of capacity building in some cases, and there is a savings component in some as well.

For processing equipment there has been limited credit available through industry, usually with guarantees or technical assistance from NGOs. For example, AgroAlpha has given inputs and tools on credit to groups associated with CARE, and has invested extensively in development, manufacture and then training on the use of machinery. AgroAlpha personnel spoke of their role in research and development of tools and machinery (J. Mutemba, personal communication, July 2002). The idea of private industry extending credit for machinery purchases was not considered viable and that is why one person indicated that "credit is the lubricant" for agricultural development, therefore development of rural financial institutions was considered necessary.

One of the difficulties for credit development in Mozambique is the lack of collateral and the poor performance in the past of solidarity group lending. In many cases, there have been no serious attempts at credit recovery with public sector special projects and farmers do not see a need to repay loans. During independence and the civil war, livestock herds were decimated and disease currently limits the range of cattle/oxen ownership, so livestock as collateral is limited to poultry or smaller animals. The numbers of these are increasing and innovative credit schemes may be able to use the small livestock for collateral in the future.

There is another financial service that is generally lacking in rural areas: savings facilities. As in many countries, farmers who wish to save do so in kind, using animals or other forms of savings. There are few opportunities to save, and while most farmers may not have sufficient means to save, those that do could begin to create a sustainable capital base for local credit facilities. GAPI staff and others have mentioned this idea as a possible area to develop. CARE and others incorporate savings components with micro-finance institutions, although government financial regulations restrict this option. Complete reliance on local rural savings would not be possible for agricultural production due to the seasonality in demand for funds. All the farmers need money at the same time and for the same basic period. Combining urban and rural savings and loan is more likely to smooth out demand on funds.

Storage and transport services are extremely limited in rural Mozambique. With a history of pan-seasonal pricing, there were not incentives for farmers to develop on farm storage for anything but their consumption goods, and large scale storage is limited to main urban areas and

a few areas in which government warehouses were located and are now managed by ICM. Transport relies mainly on large-scale traders, a few truckers, and international transporters along the main corridors (Beira, Nacala and Maputo). Rail transport along the Nacala Corridor is used for export/import with Malawi and for domestic transport as well, but is generally found to be too expensive for transport of domestic agricultural goods. All transport in the country tends to be expensive, due to the quality of the infrastructure, with roads in particularly need of development and maintenance.

4. Coverage and effectiveness of rural communications and market information systems

Rural communications generally rely on person-to-person contact, whether that is with neighbors, itinerant traders, or extension agents. There are efforts to develop community level radio stations, and commercial radio reaches populations near the main urban centers. A 2001 study conducted in Zambezia Province with about 600 households demonstrated that radio listenership was relatively high, when taking into account listening to the radios of others, with almost 90% of poor household shaving at least one member who listens to the radio (Collins, 2001). The households in the poorer wealth band are less likely to have radios, with only 27% of households owning, compared to 66% owning in the wealthy category.[19] Battery access was considered limited, particularly for the lower wealth class, and at a cost of about US$0.50, the change of batteries every two weeks, as cited by the households, can be very expensive, on top of the radio cost of US$10-15.[20] The households indicated that reception of different radio stations varies during the day and that they switch stations according to reception. Radio Moçambique (RM)-Quelimane is the most listened to, followed by RM-Nampula and other RM stations in the Mozambique (Collins, 2001). For radio ownership, about 48% of the households had at least one member who owned a radio, most frequently the household head, but 7% of radios were broken at the time of the interview. Listening depends more upon the time of day when household members are free from work than upon programming, with mid-day (2-4 pm), late afternoon (4-6 pm), and early evening (6-8 pm) as the most often cited as the preferred listening times. Radio was cited as a source of crop production information by about 45% of the households, but there was no question on market information. When asked about non-radio sources of crop production information, extension workers and family members were the each indicated by about 28% of the 411 households indicating crop production information received. The poor were less likely to have listened to crop production programs than the wealthier households (40% of poor had listened, whereas 48% of intermediate wealth class had listened and 61% of the wealthy had listened).

Given the relatively high number and frequency of rural listeners, a team developed a set of 26 radio dramas on different subjects in local languages for use in Zambezia, under the World Vision ZADP project. In Nampula Province, SEMOC has developed radio advertisements to introduce new seeds, and one agent felt that radio dramas might be a good way to provide education on both new varieties and aspects of crop management and storage, as well as other issues. The potential reach of radio is limited by the power of the transmission and topography,

[19] The ZADP survey used wealth ranking indicators to develop the three basic wealth bands for this study, based on previous work. See (Collins, 2001) for more information.

[20] In the 1996/97 Living Conditions Survey, only 20% of rural poor nationally were found to have a functioning radio, whereas 24% of the non-poor had them (MINIPLAN, UEM, and IFPRI, 1998). Given shared listening with neighbors, up to 50% of rural households may have at least one member who listens to radios.

but where it reaches, people listen. Oxfam and others are working on the development of community radios.

In Mozambique, there are various services provided under the "market information" umbrella. There are formal public sector services based in MADER and MIC; there are NGO efforts such as the FHI Bulletin in Sofala; and there are informal systems most commonly used by farmers and traders. Each of these has a role to play, and there is little duplication; there are, however, many gaps in information provided.

Since 1991, the Agricultural Market Information System (known as SIMA for Sistema de Informação dos Mercados Agrícolas) has been operating from MADER, under the Directorate of Economics, with technical support from Michigan State University (Santos et al, 2002). The system has grown and developed over time and now covers 28 commodities in 21 locations with three basic market levels: retail markets, wholesale traders, and producer level. Originally, technical support was needed to assist in even basic operations, but now the SIMA staff is responsible for all the database and publications, with technical support providing more guidance on system development and analytical tools. SIMA staff are supporting more locally based provincial SIMAs called SIMAPs, in recognition that much of the information required by farmers may be more locally based, as opposed to nationally. A recent User Needs Assessment has identified areas for improvement, many of which are on the side of greater diffusion of information. SIMA publishes a weekly bulletin called Quente Quente, distributed by FAX, email and hard copy, with some limited radio broadcasts. The development of a pilot program in Nampula Province was partially in response to identified needs for greater diffusion, as well as more locally important information.

When the SIMA first began there were radio broadcasts of the information twice weekly in different languages in six provinces, but the costs rapidly became prohibitive and there were coordination problems between the national radio and the provincial affiliates. Now, in Nampula, there is broadcast on Fridays, Saturdays and Sundays in local languages of the basic weekly price information from SIMA and the local bulletin. In Manica as well, the radio is use to broadcast agricultural price information from SIMA and from the local system when it is functioning, in local languages. In both cases, there are contracts between the radio station and the DPA.

The efforts in Nampula reflect some of the changes needed in market information, and the bulletin name change is only part of it. In a unique "Accord" signed by the Provincial Directorate of Agriculture and three NGOS (2 international and 1 local), the signers agreed to work together to ensure market information, using resources (human and financial) from each. Ultimately private sector involvement may be encouraged through sponsorships, but for now, the private sector is a main source of information on marketing opportunities for commodities.

The SIMA data collection system provides indications of the difficulties in market development. Many commodities are sold or bought in nonstandard units, particularly for producer sales. Commonly used are the 20 liter cans from edible oil that are then used for volumetric sales, although the tins are subject to "reconstruction" (denting in the bottoms, recutting the tops, changing the seams to expand the size, etc.) to lower or raise the quantity that enters. Buying and selling in these units is preferable to using scales, which are subject to even greater manipulation. Scales are relatively uncommon in Mozambican markets, except for dry fish and other selected commodities.

Another aspect that will now be included is collection of prices on agricultural inputs and basic services, information that will be collected once a month at a few key locations. Since the sellers of these are almost always separate from the other price collection locations of the SIMA, and since the prices are not found to fluctuate as rapidly as commodity prices in other countries in the region, the periodicity is less and the number of markets restricted.

SIMA expenditures are currently under the PROAGRI umbrella, an indication that MADER leadership believes this activity is valuable for agricultural development. The continual problem throughout MADER and other ministries is retention of trained staff. Currently SIMA has trained staff and that staff carries out all of the main activities. There will be a need to continually bring in and train new people. Human resources in the provinces are now a key constraint, as the need for local systems is clear, yet finding people for those jobs outside the biggest cities is a challenge. Most of the current staff members are agronomists trained in price and market analysis within MADER/DE training programs. SIMA staff are also looking at the institutional constraints in the system and looking to possible changes in institutional structure to make it more responsive and to improve diffusion (Santos et al., 2002).

MIC has a market information bulletin called the Monthly Bulletin of Agricultural Trade, published with technical assistance of FAO. The periodicity of the bulletin is not always consistent, as months may be combined into a single edition, but the bulletin provides a combination of trade and price information, with more analysis than in the SIMA bulletins. Both provide SAFEX prices, some regional analysis, and a look at local markets. The MIC bulletin provides the Food Balance sheet, to evaluate availability of foods, whether from domestic production or different types of imports. They use SIMA data for price analysis and graphics, and do not have the local data collection capacity of SIMA. There is complementarity between the two information systems, but coordination could be improved and there are still information gaps.

In view of the need for locally specific information, some NGOs have developed their own bulletins, which may include some market information, and may build on the information from SIMA. In Nampula, the accord between the NGOs and the DPA with SIMA staff was designed to avoid the need for the NGOs to each have a separate bulletin for their farmers. Diffusion is one of the weakest points for market information, and various things have been tried. FHI uses market boards (large blackboards in public places) to convey information, but in a country with high illiteracy rates, this may not be very effective. Along with the SIMA radio efforts, the IFAD project PAMA will be working with Radio Mozambique on broadcasting of market information in their focal areas, based on work with provincial level staff for MADER and MIC, but they do not currently foresee work with community radios. The expense of radio broadcasts discourages their use in many places, so much of information dissemination takes the old system of word of mouth, with email and fax helping to get the paper copies out. Internet use is expanding rapidly in the provincial capital and may prove to be the least cost, most efficient dissemination system, at least for traders and NGOs, but for farmers, word of mouth (personal or by radio) is still critical.

5. Market infrastructure

With substantial efforts since 1992, Mozambican trunk roads are in relatively good shape, except in the flood-hit zones and in parts of the north. The major problem remains the access roads between the main highways and the towns and villages of the interior. Figures 2.6 and 2.7

demonstrate the assessment of access in the mid to late 1990s. Recent work by SIMA in the center and north shows that traders stay on the main roads due to problems of access (SIMA, 2002).

There is no transport sector dedicated to agricultural commodities. The large-scale traders have their own vehicles, and the small-scale informal traders just arrange whatever transport they can find once they have the commodities. The situation has improved dramatically since 1994, for now traders usually wait 1-2 days to find transport, in comparison with two weeks or more in the past. These small traders take advantage of return trips, when truckers are just looking for extra cargo.

Port facilities in Mozambique deteriorated until after the Peace Accords, although rehabilitation efforts began with the need to get emergency food supplies into the region in the early 1990s. Direct export of agricultural goods out of Nacala Port, in particular, is key for Mozambique's competitiveness in Asian markets. Until the maritime industry is liberalized and efficiency is gained, the shipping costs for domestic destinations will remain prohibitive for most market development between north and south. There are no north-south rail lines to provide a substitute, just roads.

As mentioned previously, ICM still retains large warehouse capacity in the country, currently leased by private traders for the most part. Large private traders often have warehouse facilities in the main towns, but rarely maintain storage capacity elsewhere. The rural stores of the past had small storage capacity, but most were destroyed by 1992 and rehabilitation is slow, for a variety of reasons. On farm storage is a major problem, with losses due to pests (weevils, rats, etc.) and damage. There are low cost on farm alternatives available, but the difficulty is getting that information and any supplies needed to the rural areas.

b. Structure and effectiveness of institutional arrangements affecting farmers' access to inputs and output markets

As has been mentioned earlier, farmers' access to input and output markets is limited, although there are recent examples of success in developing market links.

There is no commodity exchange organization in Mozambique, although some traders and processors use the South African SAFEX as a market base and source of information. The idea of establishing a commodity exchange in northern Mozambique has been discussed, with a report drafted under the FAO/MIC program. While the document is not yet available, the tentative conclusions were to continue to develop the agricultural spot markets more in order to generate the volumes needed for commodity exchanges.

The PROAGRI strategy focuses on farmer associations for technology transfer and productivity gains, so they are considered quite important. Every NGO works with farmer associations, community groups, marketing clubs, or some form of organized association. There are very different approaches used by each, but in general with agricultural production, the NGO organizes technical expertise on production and storage, organizes the delivery of inputs, and arranges for the marketing in bulk by the association, often negotiating the contracts. The association members participate, but the NGO is key in the initial phases.

To look more at the role of associations, Bingen et al (2000) developed the following typology of farmer associations in Mozambique:

1) **Simple Commodity Contract Associations** are based initially on the financial investment capital of a company or traders; the services available to smallholders are supply driven (e.g., associations set up by cotton traders to facilitate input delivery and marketing).

2) **Delivery System Associations** have been established to help deliver or transfer technology; the services available to smallholders are largely mediated by an agency or program outside the community (e.g., "extension groups" set up by NGOs to provide agricultural technology and training).

3) **Marketing and Development Associations** have emerged from a continuing investment in human and social capital; the services available to smallholders are largely demand driven (e.g., CLUSA-assisted groups that receive intensive training in group organization and management skills).

There are many examples in Mozambique of each type. NGOs have identified the need to develop farmer associations in order to lessen the transaction costs and enable coordination in the markets for both inputs and outputs. The fear is that the NGO provides the human and financial resources for the associations to operate and that when they depart, the associations will fall apart. That is a major reason for the perceived need to go from the Type II associations that some NGOs foster to the Type III that involves much more human resource development, with the commitment in time and resources that this requires.

One of the barriers mentioned by NGOs and others working with association development is the difficulty in getting an association registered as a legal entity (FAO 2002). Without legal recognition, associations are ineligible for loans or other formal contracts, such as production contracts. While the NGO is there, it takes on the responsibilities, but in the long run, the associations need their own status. Howard (2000) and Bingen (2000) indicate various other aspects where public sector intervention could help.

There is no national structure for farmer associations. The closest would be UNAC, União National de Associações Camponeses, an umbrella organization, but its membership is limited to certain zones of the south. Other federation efforts are evolving in the north, with unions and fora being used to bring together several or many farmer associations, as with UCASNI (União de Camponeses de Sul de Niassa, in Niassa Province). With legal recognition, UCASNI has obtained marketing credit for its member associations from GAPI.

In a document on pro-poor growth strategies for Mozambique, Tschirley suggests that contract farming relationships between agro-processing firms and smallholder suppliers using Type I associations may be part of the solution, given the difficulties in coordination (Tschirley, 2002). Development of strong farmer associations would help ensure that farmers have bargaining power with the large-scale industry, rather than individual contracting arrangements. This would mean a shift from the simple Type 1 association to the more complex Type 3 association.

c. Major constraints to improved market efficiency and participation by the poor

The key constraints for smallholders reflect the key constraints to the agricultural sector in general as the vast majority of Mozambican farmers are smallholders, and the majority live in poverty. A recent MADER strategy document, as cited in Section 2 of this document, cites the following constraints: 1) lack of access to markets; 2) lack of access to improved technologies; 3) lack of access to credit, as well as high cost of credit; 4) rigidities in the access to and use of land; 5) lack of healthy and trained human resources; 6) lack of organizational capacity; and 7) vulnerability to natural disasters (MADER, 2001). [21]

The work of Heltberg and Tarp (2001) indicates that participation in cash crop markets tends to be highly correlated with income (based on an expenditure proxy model) and that marketing of food crops is found across income ranges such that by focusing specifically on food crop productivity and marketing, poverty alleviation is most likely to be achieved. For some of the basic food crops, there is virtually no market development, such as millet. For others, market development is weak, and producers who may have surplus are left with their stocks.

For the crops with market demand, such as maize and beans, the poor quality of on-farm storage means deterioration and losses, such that sales occur during the peak marketing time after harvest when prices are lowest. The lack of market access of the poor is most likely exacerbated by the lack of means of transport as well as lack of other assets, such as radios, that improve the chances of participating in the market. Given the risk of no traders, farmers are generally price takers in these environments, and market information will be insufficient to ensure bargaining power, unless farmer associations develop or there is competition between traders.

Current productivity levels are low in Mozambique, and yet there are relatively inexpensive productivity enhancements available, if extension messages could effectively reach the farmers. Changes in timing, spacing, and seeds could enhance yields without major investments, giving farmers surplus for market sales (Tickner 2001). Adopting new technologies will be constrained if there are no markets for the outputs and few income opportunities to pay for the inputs. With the likelihood of less schooling and lack of literacy, the poor are at a disadvantage with new crops and complicated new technologies and there is the risk illness or death when misusing pesticides or other inputs, not to mention the likelihood of not obtaining the yield benefits.

Gordon, when discussing smallholder access to inputs in sub-Saharan Africa in general, indicates that there are five main areas of constraints: availability of inputs, affordability of inputs, access to information, risk and uncertainty, overall commercial context (Gordon, 2000). In Mozambique, all of these constraints exist, in differing degrees, for smallholders, particularly for the poor. Related to the overall context, this reinforces the district level analysis that shows many districts as lacking in market access either for getting agricultural products out or for getting inputs and consumer goods into communities (Figures 2.6, 2.7, 6.1).

One of the bad precedents that has been set with public sector actions is to give inputs, including seeds, on credit and then not pursue the reimbursement of the credit, as occurred with recent inputs programs (Howard, Soares and Low, 2000). For farmers, it creates an environment in which there is no penalty for default and the idea of credit becomes confused with donations. Emergency programs also create expectations that supplies will always be free, if you wait long

[21] The constraints have been identified by many studies, including Tickner et al. 2001; Wandschneider and Garrido-Mirapeix, 1999.

enough, thus the very poor are unlikely to become input market participants any time soon, even if they have the capacity.

The high cost of fertilizers and seeds in the market reduced the profitability of their use. Evaluation of the profitability of the DNER/SG packages as used in 1996/97 shows that there are financial risks in using the external inputs for farmers unable to store maize and sell after the harvest period when prices rise (Howard et al., 1998). Given the poor state of on-farm storage, that too is risky. Demand for inputs will remain low in the absence of production credit and extension assistance on benefits and use, so, in the short term, increases in input use will probably not come through retail supplies of the inputs.

d. Scope for crop diversification and participation by poor farmers in high-value crop markets

With the emphasis on diversification and market participation, several donors and NGOs have focused on identifying cash crops for development. In 1999, EC Food Security Unit commissioned a study on cash cropping in Mozambique (Wandschneider and Garrido-Mirapeix, 1999) that focuses on several of the traditional cash crops of cotton, cashew, sugar, and tea. More recent EC commissioned work on northern Mozambique (Tickner et al., 2001) highlights a range of higher value diversification crops (paprika, ginger, chilies, white sesame seeds, and others) as well as more traditional cash crops (tobacco, maize, sugar cane, cashews) where improvements in production and processing would enhance opportunities for export.[22] They highlighted the potential of intercropped systems, including groundnut and cassava and/or pigeon pea for both profitability and food security. In sole cropping systems, they found potatoes, garlic, onions, and paprika to be potentially profitable crops under high-input production systems. Small-scale irrigation investments are an area with potential as well (Tickner 2001).

Benfica (2002) looks at agro-processing in terms of the organizational structure most adapted for production of the raw material and coordination with the processing and marketing. The most common organization in Mozambique is an agro-processing firm that relies on spot markets and purchases supplies from farmers or other traders, such that the producers are independent producers. This is common with maize and cashews, for example. The second option is contract farming, in which producers negotiate with processors or their agents prior to cropping and then contractual agreements bind the buyer and seller. Cotton is the most common example in Mozambique. The third option is vertical integration, with plantation or estate agriculture, as is found in tea and sugarcane. Smallholders participate in the last option only as paid workers. Evaluating agro-industry investments from 1985-2001, the authors found that 21% of the projects with investments were based on contract farming, 21% on plantation agriculture, and 68% based on independent producers (Benfica, 2002). As Table 6.1 indicates, the distribution of investments is not equal across the country. Recent investments in tea in Zambezia, sugar in Sofala, and maize in Maputo dominate the amounts invested and are primarily in plantation agriculture (Table 6.2). In Nampula, contract-farming arrangements in cotton and tobacco predominate. After evaluating the organizational forms, the authors reach the following conclusion:

[22] Looking at twenty four different crops, the Tickner et al 2001 report is a valuable contribution to discussions of diversification and productivity enhancements for northern Mozambique.

> The relation between poverty alleviation and the institutional arrangements governing the relationship between farmers and agro-industrial firms is not linear and is likely to be commodity specific. However, two key facts can be referred to within the current context. First, due largely to information problems and to the failure of input and credit markets, spot markets (IP) are frequently unable to support high value crops in Mozambique. If smallholders are confined to low value crops, escaping poverty will be very difficult. Second, plantation agriculture (PA) generates only one direct effect on poverty - wages - and tends to use capital intensive technologies. It will therefore almost always generate less poverty reduction than will reasonably successful CF schemes (Benfica, 2002).

As mentioned previously, contract farming is seen as one of the ways to overcome the production and market coordination problems in Mozambique. Paprika production and marketing efforts exemplify the current strategies using contract farming with high value export crops. A potential export crop is identified (either through an NGO or other donor effort with Technoserve or others), and then a private sector participant is encouraged to invest. In the case of paprika, an international company, Cheetah Paprika has joined with a local trading company V&M. Cheetah Paprika knows the crop and the markets and has the processing facilities in Malawi, whereas V&M has long experience in Mozambican rural markets, primarily trading in the main food crops. NGOs are involved to share some of the development risks and costs, bringing their skills into play, particularly for smallholder association and participation. Farmers associations provide the organizational base that reduces transactions costs for the companies. Cheetah provides seeds on credit to the farmers associations. Since Cheetah and V&M have basically a monopsony position in the current market, the role of the NGOs in ensuring bargaining strength for the farmers associations and forum is important. One of the risks mentioned in the Cheetah document is that of side-selling. Given weak contract enforcement in Mozambique, Cheetah must rely on good faith, good prices, and peer pressure to ensure that farmers contracted actually sell their paprika to Cheetah, to get the volume of operations that Cheetah needs for the investment. As the markets develop and new entrants arrive, the contractual problems for Cheetah may be similar to those experienced in the struggling cotton subsector. One of the potential difficulties of paprika as a cash crop for the poorest farmers is the degree of skill needed to obtain the quality for high returns. Training is critical, and with low literacy rates, transmission of skills takes extensive extension efforts. Since this is a crop where prices are tied to quality, farmers will need to pay attention to production, harvesting, storage and transportation guidelines to get the higher prices. This is true with few commodities in Mozambique. This is only the second year of operations for Cheetah in Mozambique, so it will be valuable to follow and assess the progress and constraints of this effort. A challenge will soon arise, as the crop will begin to need fertilizers and pest control, implying more financial resources and more risk.

Table 6.1 Distribution of Agro-industry Investments by Province (Value of Investment)

	All Rural Based Projects [1]		Agro-Industrial Projects Only [2]							
Provinces	Total Value (thousand $US)	Percent	IP Total Value (thousand $US)	Percent	CF Total Value (thousand $US)	Percent	PA Total Value (thousand $US)	Percent	Total Total Value (thousand $US)	Percent
Niassa	14,740	2	3,257	1	4,288	3	437	0	7,982	1
Cabo Delgado	71,392	7	6,379	2	33,228	25	0	0	39,607	7
Nampula	77,269	8	23,407	9	171,230	13	21,725	12	62,255	11
Zambezia	124,544	13	9,821	4	52,794	40	12,772	7	75,387	13
Tete	19,530	2	45	0	0	0	0	0	45	0
Manica	49,687	5	11,972	5	2,561	2	857	0	15,391	3
Sofala	216,707	22	19,932	8	8,678	7	72,460	39	101,070	18
Inhambane	18,797	2	15,493	6	0	0	0	0	15,493	3
Gaza	54,068	6	12,547	5	11,773	9	0	0	24,321	4
Maputo	327,215	34	15,901	61	0	0	76,009	41	235,015	41
Total	973,948	100	261,860	100	130,446	100	184,260	100	576,566	100

Source: 1985-2001 Project Database based on the CPI archives, presented in Benfica, Impact of alternative agro-industrial investments on poverty reduction in rural Mozambique: Research Report Phase I, MADER/DE, 2002.

[1] Includes rural based projects in agriculture, livestock, forestry and wood-processing, and agro-industry.
[2] Agro-Industry refers only to projects that have a processing component, with or without a direct production component: IP=Processing with independent smallholder producers; CF=Processing with contract farming; PA=Processing with plantation agriculture.

Table 6.2 Commodity Sub-sectors by Institutional Arrangement and Location

Commodity Sector	Share of Agro-industrial Investment Projects[1]				Share of Value Invested in Agro-industrial Projects[1]				Location (provinces) — top three ... —	
	IP	CF	PA	Total	IP	CF	PA	Total		
	% within type of link (% within commodity sector)				% within type of link (% within commodity sector)				... in % of investment projects	... in % of value invested
Maize	29	0	9	20	24	0	0	11	Maputo	Maputo
	(91)	(0)	(9)	(100)	(99)	(0)	(1)	(100)	Nampula	Sofala
									Sofala	Nampula
Oilseeds	19	14	5	15	7	3	0	4	Inhambane	Inhambane
	(76)	(18)	(6)	(100)	(80)	(18)	(2)	(100)	Nampula	Nampula
									Maputo	Maputo
Sugar	1	0	9	3	42	0	74	42	Maputo	Maputo
	(33)	(0)	(67)	(100)	(45)	(0)	(55)	(100)	Sofala	Sofala
Tea	2	10	24	7	2	22	7	8	Zambezia	Zambezia
	(12)	(25)	(63)	(100)	(9)	(63)	(28)	(100)		
Cotton	2	62	0	13	0	67	0	15	Nampula	C Delgado
	(7)	(93)	(0)	(100)	(0)	(100)	(0)	(100)	Zambezia	Zambezia
									Sofala	Nampula
Tobacco	1	5	5	3	1	0	0	1	Manica	Maputo
	(33)	(34)	(33)	(100)	(71)	(9)	(20)	(100)	Maputo	Manica
Cashew	31	0	0	19	16	0	0	7	Nampula	Nampula
	(100)	(0)	(0)	(100)	(100)	(0)	(0)	(100)	Maputo	Gaza
									Gaza/Inhambane	Inhambane
Fruits	12	0	0	7	7	0	0	3	Manica	Manica
	(100)	(0)	(0)	(100)	(100)	(0)	(0)	(100)	Nampula	C Delgado
									Gaza	Nampula
Other[2]	3	9	48	13	1	8	19	9	Maputo	Nampula
	(14)	(14)	(72)	(100)	(11)	(20)	(69)	(100)	Nampula	Maputo
									Zambezia	Gaza
Total	100	100	100	100	100	100	100	100	Maputo	Maputo
	(62)	(19)	(19)	(100)	(45)	(23)	(32)	(100)	Nampula	Sofala
									Zambezia	Zambezia

Source: 1985-2001 Project Database based on the CPI archives, presented in Benfica, Impact of alternative agro-industrial investments on poverty reduction in rural Mozambique: Research Report Phase I, MADER/DE, 2002.

[1] Agro-Industry refers only to projects that have a processing component, with or without a direct production component: IP=Processing with independent smallholder producers; CF=Processing with contract farming; PA=Processing with plantation agriculture.

[2] Other include mixture of crops: predominantly imported raw material, rice, coconut, pigeon pea, etc

A new pigeon pea processing plant project in Zambezia will be important to follow. As with the paprika experience, the private sector is linking with NGOs (World Vision and the Christian Council, in this case) to develop pigeon pea contract production with 5,000 farmers on land that the private company owns. The private company, Sagar Zambezia Limitada is a joint venture company with Mozambican investment and Sagar, a major Indian agri-business company. While Sagar Zambezia has obtained use rights on 6,000 hectares, it does not want to farm itself; the pigeon peas will produced by small farmers with contracts. For full utilization of the plant capacity, they will also need substantial supplies from farmers outside the actual plant lands. The dhal produced will be exported to the Middle East and Asia. World Vision will help to coordinate the supply of inputs (particularly seed) and organization of farmer production and marketing groups/associations. ICRISAT will be involved in the provision of foundation seed for the needed varieties and help provide some technical assistance on the production of seed. This project has developed out of USAID funded work by Technoserve on the identification of opportunities (TechnoServe, 1998). Following its progress is needed, as there are various issues related to contract mechanisms and enforcement that will challenge the viability of the system, if other more profitable crops can be grown and marketed. In the Namialo region, there is also collaboration between AGRIMO, a Mozambican company, and UEM with EC funding to develop diversification crops, including pigeon peas.

As mentioned earlier, Gordon and Langworthy (1999) conducted a study on the edible oilseeds subsector for CARE in Mozambique, and found good potential for small farmers with sunflower seeds, as the small-scale presses mean there is a readily available local market. There have been issues with monopsony control being using by the owners, offering a low price, as they are the only buyer. CARE has funded small-scale ram presses for rural households as a way to improve income earning potential as well as enhance household diet. They find that the ram presses are valuable and should be continued, "particularly in relatively remote areas that still have some population concentration" (Gordon 1999). Three special areas of effort are needed: 1) training on the machinery in rural areas; 2) financing, so that farmer associations or local entrepreneurs can buy the machinery; and 3) seed multiplication and marketing to ensure commodity supply. For sesame export production as well as the production of other oilseeds, the main constraints are degeneration in quality as local varieties contaminate the white sesame seed, and some bird and other pests in cropping.

Depending on prices and program aid imports of oil, the potential for growth in this sector is larger in the north and parts of the center due to transport costs for imported oils. In the south, domestic oils do not compete well with imports and prices are lower for both South African and Asian imported oil. One of the aspects that will be discussed later is the lack of quality standards and pricing, such that higher valued pure sunflower oils are not identified and priced in the local markets and returns to producers are limited. Sunflower oil, a preferred good, is simply sold as "vegetable oil" and receives the lower prices of mixed vegetable oils (Tickner, 2001). With low prices, the local presses are seeing competition, as local prices for sesame seed oil are too low to compete for the sesame seed. Almost all sesame production now goes to raw exports, more that 7000 MT were predicted for 2001 (Tickner, 2001). Producers shift production from sunflower to sesame, thus reducing the oilseeds available for local processing.

The most recent work on agro-processing takes two approaches: 1) identification of viable commodities and products for small and medium scale agro-processing investments (Muendane, 2002; GPSCA, 2002a; GPSCA, 2002b); and 2) agro-processing potential for poverty alleviation (Benfica, 2002). The two directions of work have highlighted some commodities or areas for

development. In the initial phase, the GPSCA work focuses on agro-processing only along the coastal areas of Mozambique.[23] The GPSCA is concerned with private sector investment in activities, and not necessarily with the role that small-scale farmers might play in this. As was discussed earlier, the Benfica (2002) work complements this with the criteria for smallholder participation in production and the links between commodities and the systems that develop for them.

The GPSCA work indicated the following crops/commodities with good potential for profitable investments for the private sector: 1) production of charcoal from coconut shells; 2) production and sales of coconut fiber for woven products; 3) production of the woven products from coconut fibers; 4) cutting and milling of degraded coconut trees; 5) fermentation and distillation of cashew pear alcohol; 6) shelling and exportation of cashew nuts; 7) production and sales of dried fruit; 8) packaging and export of fresh tangerines; 9) packaging and sales of high quality bananas; 10) production and processing of pigeon peas and other pulses; 11) production and processing of de-hulled rice; 12) drying and processing of cassava; 13) processing, packaging and export of groundnuts (especially small Spanish style peanuts); 14) buying, processing, and packaging white sesame seeds; and 15) oil processing of groundnuts, sunflowers, and sesame. For each other these activities they highlight the locations with best opportunities and the constraints to possible development that need to be overcome. They looked and found no agro-processing opportunities at small or medium scale neither for maize nor for sweet potatoes. Using the Benfica (2002) analysis, some of these activities are not likely to alleviate poverty. For example, the banana export requires substantial quality control throughout the process and is likely to involve just the better off households or farmers just as laborers on a plantation. Others may have the potential to alleviate poverty by increasing market demand for a crop that the poor grow (processing of pigeon peas and other pulses, groundnuts) or providing appropriate processing technology for local demand (cassava).

e. Current donor efforts in input and output markets

1. Who is doing what

At the time of the signing of the Peace Accords, Mozambique was considered the poorest country in the world with per capita annual incomes of less that $75. With peace and a government stresses reforms and economic development, many international NGOs and donors began or expanded programs there, particularly in the rural sector. As reflected in many project documents (e.g. Unidade de Seguranca Alimentar, 2001), agricultural development necessitates enhanced input and output markets in Mozambique. We cannot possibly document all the activities of these agents, but will highlight selected NGO (international and local) and donor activities.[24] PROAGRI activities are considered a major focus of agricultural development funding for the main cooperating partners, including Asdi, EC, FAO, Finland, GTZ, IFAD, Ireland AID, Italy, JICA, the Netherlands, Portugal, Spain, UNDP, USAID and the World Bank. Most of those partners have committed to working through PROAGRI with funding, leaving only special projects with NGOs for additional special funding. This places a heavy reliance on MADER resource allocation to ensure programming execution.

[23] Niassa is also included but only one activity, dried fruits, was highlighted for Niassa (Gabinete de Promoção do Sector Comercial Agrario (GPSCA), 2002b).

[24] For further information, the World Bank presents a Framework for Development Partnership in Annex E of its 2000 Memorandum that lists the major donor activities by sector and indicates basic activities and funding levels (World Bank, 2000a). Some project activities have already been discussed earlier in the document.

In 1999, the International Fund for Agricultural Development (IFAD) developed the Program to Support Agricultural Markets (Programa de Apoio aos Mercados Agrícolas, PAMA), a US$22.3 million, seven year project which has only now become operational with bids out for various services PAMA (2002). They are currently implementing the work in selected districts of Cabo Delgado and Niassa Provinces and expect to begin in three districts of Maputo Province in 2003. IFAD has designated the majority of the funds for provincial level work with MADER, MIC, and the Ministry of Public Works with eight types of activities: 1) development of farmers groups/associations; 2) rural access road improvements (labor-based construction); 3) improvements in rural financial services (particularly inventory credit); 4) training of rural traders; 5) private sector forums in the provinces; 6) dissemination of market information at provincial level; 7) support to small-scale processors; and 8) agricultural production initiatives, to identify new opportunities and possible ways to link production and sales, with inputs for farmers. In addition to the provincial level work, there are funds to support strategic activities in MADER (including DNDR), MIC, and the Autoridade Rodoviária (ANE), including training for a new Policy Analysis Unit at MIC, and recruitment and provisioning for a team at DNDR for a new Assessment of Local Needs Team, as well as funds for a promoter in DNER for farmers associations. ANE will also receive funds for new personnel and equipment. A national-level Fund for the Support of PAMA has been established to support microfinance activities, fund feasible studies on commercially viable alternatives, and impact studies on the training of rural retailers aimed at expanding access to agricultural inputs. The latter will also identify successful cases that could be expanded. The main operational mode will be to contract individuals or entities to complete the work, outsourcing the activities. Bidders will likely include NGOs but also private sector agents. This combination of human resource development and physical resources will assist mainly in the specific focal areas of the PAMA work, in Cabo Delgado, Niassa, and later in Maputo Provinces.

The European Commission, through its Food Security Unit in Maputo, has developed agricultural and market directed programs in selected provinces in northern Mozambique (Nampula, Zambezia, and Cabo Delgado) and in Inhambane and Gaza (Unidade de Seguranca Alimentar, 2001). In these food security programs, the EC funds programs in agricultural production and diversification, organization of farmers' associations, and support for agricultural marketing, including work with CARE, CLUSA, PASANA, OLIPA, World Vision, Movimondo, AMODER, and others. Working through local and international NGOs and the provincial offices of MIC and MADER, the EC program of funding seeks to improve farmers' opportunities, while expanding market activities of a range of agents. Linking farmers and traders is seen as a key to sustained improvement in food security. EC has funded several important studies that serve as an information base for action. For example, there is recent work on identification of cash cropping alternatives (Wandschneider and Garrido-Mirapeix, 1999) and on options for crop improvement and diversification (Tickner, 2001). The EC also funds some aspects of the FAO project in MIC for rural market development. There is currently reorganization in the EC regionally and so the Food Security Unit may experience changes in its mandate and resources, but agriculture will continue to receive substantial funding (up to 15% of the mission portfolio) (European Commission in Mozambique, 2002).

World Bank with IFC is committed to supporting PROAGRI and will channel most funds through the PROAGRI mechanism in MADER. They are funding a decentralized Rural Action Project to fund community-driven small-scale rural infrastructure and community investments. They will also fund the Roads and Bridges Project to improve rural infrastructure, and small and

medium scale rural enterprises through the IFC Programme (World Bank, 2000a and 2000b). IDA's Enterprise Development Program PODE provides funding for vocational and other training for private entrepreneurs to help improve market skills and enhance enterprise activities, including rural trade and SME development in agro-processing.

While much of USAID funding is channeled through PROAGRI, there are some special programs funded by the mission using proceeds of the program aid. Various NGOs benefit from this funding, although there are signs of reduction with the efforts more concentrated in the PROAGRI umbrella.

NGOs obtain funding from a range of donors and their programs are influenced by the donor objectives, so separating the donor and the NGO is not always effective for analysis. With PROAGRI in MADER, some donors, including DFID (1998), are channeling most of the development aid through MADER and funding less NGO activity. In the agricultural sector there are various large international NGOs working in agriculture and markets in Mozambique: CARE, CLUSA, Africare, World Vision, Food for the Hungry Intl., Oxfam, ADRA, Action Aid, and World Relief. USAID funding is very important, but there are other sources as well. While there is increasing consensus on the need for diversification of production, increased market opportunities (both inputs and outputs), improved production technologies, and enhanced farmer associations, each has its own approach and emphasis. Generally there are geographical foci for each NGO, and the donor influences the decision.

Oxfam is represented in Mozambique for five different Oxfam country programs. Oxfam/Great Britain and Oxfam/Canada mainly complete the agricultural sector work. Oxfam/Belgium is working with radio programs, but not specifically oriented to agriculture. They have also started funding the União Geral das Cooperativas- Nampula that will provide capacity building for local cooperatives and associations, with an agricultural focus. The different Oxfam country programs are working to coordinate activities in Mozambique, with harmonization as a goal. They wish to build on partnerships with local institutions, including UNAC, UEM, and ORAM. Oxfam/Great Britain has supported some of the SARRNET efforts with sweet potatoes and the staff member we spoke with indicated that the program was successful and provided an excellent example of work that can be expanded (Walls, personal communication, June 2002). Sweet potatoes have a range of characteristics that make it valuable: 1) it is a crop that mostly women cultivate; 2) it has low labor demands, and 3) it doesn't require high technical skills, and 4) it contributes substantially to household nutrition, particularly important for households with people affected by HIV/AIDS.

There are various donor-sponsored efforts at training rural stockists to handle inputs and arrange financing for the stocks. In Manica Province, the Citizens Network for Foreign Affairs (CNFA) is conducting such training, based on work in Malawi and Zimbabwe. CLUSA is working with some farmers associations to train them on the management of input supplies and distribution. CARE has experience in Zimbabwe with the AGENT program that trained and helped finance 291 stockists, of which many are still operating. In rural areas with high potential and increased crop marketing opportunities, these efforts are important, but in low potential areas, they may not be as effective. CLUSA has also proposed that more resources be allocated rural group enterprises that could become wholesale trade associations (CLUSA, 2001).

The Adventist Development and Relief Agency (ADRA) works mainly in the south in relatively low potential zones, as well as in Zambezia. As with many NGOs here, they started originally

in emergency programs and have shifted to development programs, now focusing mainly on agriculture. Vegetable production was one of the programs that have proved successful in diversifying diets of the poor, as home consumption was the destination for the vegetables. The success is such that the households may soon have surpluses and no market to sell them. They have been working with fruit tree nurseries and once again ran into the problem of lack of markets for the fruits and lack of transport to arrive at markets. ADRA is involved in sweet potato diffusion efforts as well, along the same lines of improving nutrition through diet-based methods. Cashews have become an important cash crop alternative for the households, since cashews are easy to handle and not perishable, so that farmers can wait for transport. Cashews also can contribute significantly to household diets as well. ADRA is now looking for household processing tools so that farmers can gain more value added in cashews. There is also training on cashew tree planting and maintenance and is training extension workers for this crop, but they see working with lead farmers as a more sustainable, cost effective way to ensure technology transfer in local areas. They have been selected by MADER for some outsourcing of extension, given their approach to training both extension agents and farmers. ADRA has used radio broadcasts for some of the extension messages, but the costs of the commercial radios and the lack of range of the community radios have discouraged this effort. As is common, they work to develop farmer associations and have worked with CLUSA and others in this effort.

Food for the Hungry International (FHI) is based in Sofala Province and is actively seeking alternatives for market diversification for farmers in the region, using marketing groups of farmers. They have developed various tools for market information, including market boards in selected marketplaces. FHI has worked with farmers to look at preferences, but they do not have a mandate for research work from the donor. They are primarily working on basic food crops, with a combination of soil fertility and market approaches.

Africare, with its Manica Expanded Food Security Initiative, includes substantial efforts at developing markets while improving productivity of both cash crops and food crops. They explicitly link agriculture and nutrition education with the families. Thus, they promote the orange-fleshed sweet potato multiplication, production and consumption, along with new work on soybeans. A variety of approaches are used, as they work with formal and informal farmer associations, in collaboration with ACDI/VOCA. For technology development and transfer, they use farmer field schools as well as family field schools for the nutrition and health components. Training on improved on-farm storage is included. Contract farming options are being investigated. AFRICARE has begun a large effort at oilseed processing, with the goal to have local industries making the presses for local use, with processors forming a business association. They have not been involved in credit activities, although they have collaborated with others, including GAPI and ADIPSA.

2. Achievements, strengths and weaknesses

Progress has been made with developing markets, but much of it has been uncoordinated and patchy. NGOs and donors have clearly seen the need to connect agricultural productivity to farmers' incentives, particularly market based incentives. Improving the yield on crops for which there is no market outlet has a limited impact, and if it costs money to buy inputs, the technology will most likely not be adopted. The demand side of input use has become an issue. Where farmers have seen a market opportunity that requires an investment, they have invested, although without contracts or in-kind credit, they may not have had the resources to invest.

There are small gains in the seed sector, with successful development of community seed multiplication for some crops, and contract seed multiplication now being used. With the seed multiplication for SEMOC, there have been quality control issues and the need for seed quality evaluation systems and clear contract guidelines is clear if SEMOC is to continue contracting out multiplication to small holders. For multiplication of planting materials for cassava and sweet potatoes, there is a need to evaluate the success of the programs, particularly the distribution systems.

Credit has been successful in developing some micro-enterprises, such as the small ram presses and other processing equipment. The small amounts of credits given for trade and commerce and for agricultural marketing have seen success, but the overall effect of these programs continues to be small. Production credit is limited to contract farming, and working with associations seems to be a way to reduce defaults and lower the costs. New cash cropping initiative in paprika provide an example of contract farming success, but relies heavily on the contributions of NGOs for training, extension, and coordination of farmer associations.

For extension, marketing, and production development, farmer associations have been promoted strongly. Each NGO or donor has an approach to their development and different types of associations are to be found throughout Mozambique (Bingen 2000). These are relatively young organizations still, so it remains to be seen how sustainable they will be. CLUSA efforts have been intensive in selected zones and the question now is whether and in what condition they will survive. While CLUSA has not yet withdrawn, a local NGO is now taking on more responsibilities, as are the farmer associations and fora involved. Traders and processors have new experience working with these associations, providing the basis for continued business relations. The combination of efforts would indicate good potential for survival for many of the CLUSA associations. As more and more associations and fora become organized, it remains to be seen which type of association can sustain itself after the international funding and support are removed.

3. Future Plans

There will be continued emphasis on output market development from many of the donors. Related to this is the development of more private-public partnerships for the provision of inputs, particularly seeds. With the movement to place most agricultural development funding under the MADER PROAGRI program, some of the previous research and extension undertaken by NGOs may be under-funded. Farmer associations are seen as a major area for public sector action, yet the major investments by CLUSA, CARE, and others cannot be replaced by the MADER initiative.

Rural credit for commercial activities will continue to rise, particularly for the fast turnaround agricultural marketing activities and small-scale enterprises. Agricultural production credit remains an area in which no solutions are forthcoming, other than through contract farming arrangements and in kind loans for inputs. Given this, attaining productivity enhancements through purchased inputs will be difficult in crops that do not lend themselves to the contract-farming model. Savings mobilization in rural areas may be part of the answer, but most likely for the trade and micro-processing activities, although small livestock or vegetables with a faster income stream might benefit from local Microfinance funding.

There will continue to be efforts to identify niche markets for Mozambican agricultural products. The work of Benfica and GPSCA indicates some directions to go, and there are plans for obtaining financing for some of these processing facilities. As research indicates, where contract farming is adapted, the chances of poverty alleviation are greater.

A relatively new development with unknown implications for Mozambique is its inclusion in the new USAID Agricultural Initiative to Cut Hunger in Africa (AICHA) (USAID, 2002). It is one of the selected pilot countries for efforts to "decrease hunger through pro-poor agricultural growth" (IFPRI 2002), but the content of the USAID/Mozambique mission program for this is still in development.[25] In addition, the president of Mozambique is now a co-chair of the Partnership to Cut Hunger, an independent effort formed by U.S. and African public and private sector institutions and international humanitarian organizations to assist in the formulation of US policy for Africa (Partnership to Cut Hunger in Africa, 2002).

4. Major gaps

Gaps in Knowledge

There are various aspects of market development and growth in Mozambique that need further research or information. One is a basic question on market places. : What combination or strategy of markets with rural periodic markets, rural stores, stable rural markets and itinerant traders best provides for sustainable market development? There may be different answers for this depending on production potential, consumers and population density, transport infrastructure and other considerations. The government role in promoting these different types of markets then comes into question as well.

For development of input supply systems, there are different key agents identified. Can the informal sector, possibly combined with periodic markets, be instrumental in developing these markets, traveling the country with small bags of inputs? To what extent can commercially viable input supply systems operate throughout Mozambique, given relatively low population densities and very low-income levels?

Diffusion of extension and marketing messages generally relies on the public sector. What are the private-public sector partnerships that might overcome the information constraints in rural areas, without high public sector expenditures? While there has been some research on rural communications for market information and development, there are lessons to be learned in West Africa and elsewhere that might bring the technological revolution to Mozambican farmers.

While years of research have been put into the development of agricultural credit systems, most of the past experience in Mozambique has been associated with the public sector and very poor results. The current patchwork system provides only for some marketing and some processing activities, but not for the basic production that enters the market. Will it be able to develop into a more comprehensive rural credit system, or remain a patchwork primarily serving the fast and profitable trading activities?

Related to that, will input purchases increase without the development of a credit system for farmers? Very few farmers purchase inputs now without some form of credit. Is contract

[25] See the USAID statement on the AICHA for more information on the direction the work will be taking: http://www.afr-sd.org/Agriculture.htm .

farming the only alternative for production credit and for input use? If so, what system can meet credit need for inputs for crops not under contract farming? Can community seed systems help overcome the credit barrier by encouraging barter systems at a local level, such that the poor can access technology? How does this interface with private sector seed development? Under what conditions can the efforts to fund and train rural storeowners for seed and input sales be successful?

Given the emphasis on farmer associations, there is still much to learn about how strong and effective associations come to be. Can and do contract-farming associations (marketing associations) evolve into stronger farmer associations capable of greater development initiatives? How important is it for the farmers that they do evolve? Another relevant issue for farmer associations is the role of women, who are generally excluded from cash cropping associations and contracting. CLUSA staff believes that literacy training is one of the keys in ensuring that women as well as men can participate and benefit from associations. Are there other keys and lessons to be learned to ensure that the poor can participate effectively in organizations?

Gaps in investment

The gaps in information and research are related to observed gaps in investment, for where there are questions, the investors remain ambivalent. In Mozambique, there are currently many small projects investing in activities of seed multiplication, training stockists, cash crop market identification and development, farmer associations, and many other things. Below, we identify a few areas in which additional or new resources could be effective at market development for the poor:

- Rural communications for market development: development of market extension materials for different means of communication, determination of effective means for reaching the poor, development of local information systems with private partnerships.
- Rural periodic markets
- Rural Credit and Savings systems
- Testing innovative input distribution systems with small quantities, trained rural traders
- Seed system investments for the development of regional seed regulations with partners, SADC system efforts
- Seed multiplication and development of commercial seed producing associations
- Cash cropping and processing alternatives for cassava and sweet potato
- Rice marketing development based on qualities and the development of a market for higher quality domestic production (along with the small scale irrigation to grow it)

7. Strategic RF Opportunities – A First Approximation[26]

a. Major gaps and priority unmet future needs

The Mozambican PARPA emphasizes the importance of the agricultural sector, but in the budget allocations, agriculture is down the list. It is through investments in infrastructure, education, health, and good governance that a growth environment for agriculture will be established. Direct funding to agriculture is limited, and PROAGRI was developed to enable MADER to better allocate the limited resources to its priority programs, but there remain areas in which the funding and staffing are inadequate to achieve the poverty reduction targeted.

[26] This chapter is an extended version of the chapter in the document submitted to Rockefeller.

Some additional funding is contributed by the donors and others to complement these activities with targeted actions, through NGOs and private agents. In determining where there might be gaps and unmet needs, the Rockefeller Foundation Food Security Program seeks "to support technological change, policy, and market development, and institutional development in achieving higher rates of agricultural growth and reductions in poverty" (2002).

The combination of growth and poverty alleviation may be best achieved through food crops and can be achieved through the development of small-scale agriculture (Carrilho et al 2002). Based on analysis using the 1995/96 IAF survey data, Heltberg and Tarp see agricultural growth as occurring by bringing subsistence farmers into the markets. They suggested, "the key policy implication is to focus on targeted efforts to build up farm capital, improve market access and diffuse new crop technologies, while also paying attention to smallholder's investment incentives" (Heltberg and Tarp, 2001, p.4). While participation in traditional cash crop markets tends to be highly correlated with income (expenditure proxy), marketing of food crops is found across income ranges. This reinforces a strategy for rural poverty alleviation that focuses on improved productivity and marketing for food crops in Mozambique and there are some important gaps in current work on food crops.

Research does not always fare well in public sector budget negotiations, and agricultural research in Mozambique is no exception. Traditional breeding capacity at INIA is limited, so the development of locally adapted varieties of maize, cassava and other food crops is severely constrained. Biotechnology could complement traditional breeding, speeding up the development period for new cultivars, as the use of molecular markers assists in the selection of desirable germplasm, but the human and financial resources to develop this capacity are not available. When new varieties are found, there is a gap in the production of base seed and in the process to certify new varieties for release. Beyond varietal development, there is the need for additional basic and adaptive research on cropping and soil fertility systems, evaluating both low input systems and crop intensification to find new options suited to Mozambique. Profitability and other criteria need to be evaluated in the development of these options as well.

There are various other aspects in which the government does not have the needed resources to respond. Regarding GMOs and biotechnology, the Mozambican government does not yet have a strategy, but is working to develop at least an interim strategy. The main problem is the lack of skilled scientists to respond to the requests of the leaders both in the public policy side and on the technical side. As noted by Pingali and Traxler (2002), private incentives are low for biotechnology and other technology investments in open-pollinated crops and crops grown primarily in marginal areas. This lack also applies to more cropping systems research for those marginal areas. Technology investments can also be very costly with high payoffs only several years later, limiting the value of short term investments. Biotechnology has the possibility of cutting the varietal development time, but there will be time needed to get a research program up and running.

At the farm level, quality and availability of seeds are mentioned by many as constraint and as a potential major source of productivity gains in almost all crops grown in Mozambique. As noted earlier, the seed subsector is a combination of many efforts, public and private partnerships with firms, NGOs, community and farmer associations, and the public sector all involved. There is a major need for strategic actions in the seed sector. Given all of the efforts so far, there is much to learn from experience of what works and doesn't work, yet there is no one to pull it all together and then help develop strategies for each of the main food crops and

the zones of work, based on Mozambican experience. As markets develop, private and public sector need to have the capacity to respond to the demand and that capacity is not yet there.

With other markets, including fertilizers and crop outputs, the development of rural markets and the relationships between formal and informal agents, as well as the role of different types of market places and contracting has received some attention, but there are still gaps. Pilot projects and evaluation of experiences could provide the needed information before any major investments by the public sector are made. When there is success in generating agricultural surpluses, market development becomes the critical constraint. Can the lack of markets be met by the development of periodic rural markets or through the old rural stores or more established rural markets? In Mozambique, with the different regions of the country, there is a need to evaluate what types of market structures are most likely to achieve success. Currently, while the question is raised, there has not been the investment made to answer the question. The answer may be different for different regions of the country, so taking lessons from one area may not yield the best results elsewhere.

Market information is one of the key functions that can be served through public/private partnerships. While the current SIMA is active in each province, pilot work in the north is gaining momentum in such partnerships. There is still much that could be done to improve the diffusion of information and the coordination of information and analysis using modern communications technology such as radio-telephones and computers.

To enhance productivity and bring small-scale farmers to the market with production surpluses and new crops, extension activities are undertaken by an increasingly broad set of participants. As indicated by Eicher (2002), there is a need to evaluate the performance of the efforts, highlighting strengths and weaknesses and conditions for successful technology development and transfer. Each NGO has their model, the public extension system has used different models, and recent private efforts are yet another approach, from which lessons can be drawn to guide future investments. There is no current way to meet this need, a critical input for extension strategic planning. With decentralization of extension, MADER will be unable to put into operation its coordinating role if the capacity for this is not developed.

Post-harvest losses affect most of the food crops and are thought to be relatively high in Mozambique. There are some technologies available for maize and other grains for improved household silos, but there is a need to evaluate the methods and take a systematic approach to extension messages and farmer adaptation on post-harvest methods for grain storage. For the tubers, there is still major work to be done on post-harvest issues. One aspect is improving the quality of cassava and other tubers when stored. Generally, households need to eat or sell the crop quickly when they harvest.

Related to the development of markets, there are major gaps in the development of processing technologies. Technologies from other countries may be valuable (Nweke, Spencer, and Lynam, 2002), but trained scientists as well as extension agents are needed to adapt the technologies. Incorporating the processing and consumption needs into the breeding programs also requires skilled members of the research team. Cassava is a good example of a crop grown by the poor, for which there is the potential to improve marketability through breeding and processing.

While considered a traditional cash crop, cashews are often consumed in the home, may be processed for informal local sales, and are grown principally by smallholders. Finding the appropriate processing equipment and developing domestic processing on small-scale basis could make a big difference in zones of the south, where agriculture is precarious, and improved production and processing could contribute significantly to household nutrition directly in consumption, as well as to income through informal sales.

Some constraints to smallholder production may best be evaluated and reduced through regional efforts involving researchers from several countries, for the problems are not just Mozambican. For example, cassava brown streak was thought to have arrived through Tanzania and is currently affecting Mozambican harvests in the north (Hilton and Sousa, 2002). Lethal yellow in coconuts poses problems elsewhere. Various agents felt that regional research and solutions are the best approach, and that more support for such regional efforts would be important for these food crops, as well as coconut and cashews, are grown by the poor for cash income as well as home consumption. Regional seed harmonization needs have been mentioned as well, requiring coordination and discussions with other countries in the region. The issue of GMOs and biotechnology has regional implications, as demonstrated in current debates on food aid for the region. The exchange of ideas and information is only now beginning to take place to inform policy.

PROAGRI is a key government opportunity to develop the Ministry's program and look toward the future. There is a crucial component affecting all aspects and that is the general lack of trained and qualified personnel, in extension, in research, in policy and program development. Given low salaries and lack of resources for creating a stimulating and effective workplace, personnel leave for private and NGO employment. Both the working conditions and the benefits are better outside the public sector in agriculture. The creation of a positive work environment and adequate benefits must be achieved to make progress with agricultural technology development and diffusion. In research, in particular, creating centers of research in which professional exchange is high and technology access is good (computers, communication, laboratories) can make a difference in researcher and technician satisfaction, as well as quality of output. In addition to work conditions, housing and transport are needed on the to attract qualified scientists to live outside the main cities where the research can be most effective. Links with extension could also be improved, but the public sector agents also require sufficient resources and training to do the job.

b. Leveraging with other donors

Donors are allocating funds to identification of cash cropping alternatives and market development, particularly in the high potential areas. However there is little funding for agricultural research outside the PROAGRI funding mechanism, particularly for the basic food crops. As one NGO representative stated, the donor indicated to them that the NGO should no longer conduct research, but rather should work with farmers in the extension of results from research by the public and private sector. NGOs are in a position to assist in developing better links between research, extension and farmers.

In evaluating potential cropping systems, Tickner et al. (2001) indicate maize yields that could be improved to 0.8 tons with low intensity improvements and 1.8 tons with the intensity option, compared to the average of 0.5 tons found in 1996; rice yields of 1.5 tons compared to average yields of 0.4 tons; groundnut yields currently at 0.2 tons could reach 0.55 tons with low input

improvements and 1.2 tons with higher intensity option (see Part III Matrices in Annex C for crop by crop evaluation). There is some work currently on low input options or conservation farming (CARE in Nampula, for example), but the work is patchy and could use a more coordinated effort with research and extension. Also, the regional efforts with this are important and should be supported, as with the African Conservation Tillage (ACT) Network.

With the efforts of various donors (and NGOs with donor funding) to identify cash cropping alternatives, the research component is often left out of the discussions or unable to meet the needs when the time comes, so external experts are hastily brought in. NGO funding for local research has been reduced with PROAGRI, so an increasing gap between opportunities and effective realization may occur, with the inability to match varietal demand to supply.

There is also the assumption that coordination problems between farmers and input supplies can be resolved through training rural traders. While there is little evidence that knowledge is the main constraint to rural traders working with inputs, if other constraints on the demand side for inputs are resolved, knowledge of traders would then come forward as a constraint. The credit efforts for rural traders respond to an identified constraint and learning from the current efforts before major new investments may avoid the pitfalls of previous agricultural sector credit programs. Combining credit and training programs thus appears to be the best way to enable traders to undertake the new activities and for farmers to have better access to seeds, etc.

Market information in increasingly available for the basic commodities, although agricultural inputs, including seeds, are only just now being included in the system. Dissemination is one of the areas that would benefit from further assistance, particularly the use of radio for public dissemination. There may also be opportunities to improve the data transmission and communication between SIMA systems in different places in Mozambique, using the radiophone/computer technology found in the Mali SIM .

Credit for farmers remains a major area of weak efforts and frustration for many. One proposal is to invest more in local savings development to provide the funds for local agriculture, but unless the urban sector has strong savings power and views the agricultural sector as a good investment, the seasonal demand of agricultural credit may not be easily met through local savings generation. This is another area for policy research.

For seeds, many of the NGOs and farmer associations working with cash cropping and diversification have experienced the lack of quality seeds available on the market. There are currently many separate programs to multiply seeds of specific crops for specific projects. Some farmers associations have been trained and are multiplying seeds on contract for NGOs or for the private sector. These are individual efforts at resolving an immediate production constraint, but creating a viable seed system for both commercial and food security objectives in Mozambique requires a broader vision. The National Seed Strategy Seminar in 1999, with technical assistance from ICRISAT and MSU, proposed strategic actions and the follow-up conference in 2001 are positive steps that need continued support.

Farmers associations are viewed as the major institutional innovation to reduce the coordination problems and high transaction costs in the Mozambican environment. It may be the better off farmers that are able to take advantage of farmers associations, but poorer farmers may be able to benefit either directly or indirectly from the presence of associations. While many donors and NGOs are working actively to establish farmers associations, the legal/institutional aspects have

not been systematically understood or dealt with. CLUSA, after years of struggling to get just a few farmer associations registered, is now focused on getting forums registered, for many more people are involved, making the process more cost effective (Colon, personal communication, 2002). Also, the Bingen et al. (2000) research shows that there are different types of associations, some more sustainable and some more likely to alleviate poverty. Within the PARPA and PROAGRI, the government advocates farmer associations for rural development, but lacks the trained people to identify a coordinated approach to developing viable associations. There is more interest funding from donors to specific activities with farmer associations, than for research to understand how that development can be done to have the greatest impact.

Related to this is the lack of social scientists within the research system. Rockefeller Foundation has long identified this need within the CGIAR and it is also a problem in the NARS. Participatory breeding programs, farmer field schools for technology development and technology assessment all require skilled social scientists, yet INIA has not a single social scientist to help ensure the quality of such programs. With research funding from the donors brought into the PROAGRI umbrella, it is not clear how much funding will be made available to train and recruit these scientists, even though the donors wish to see participatory research development and greater links between researchers, extension agents, farmers, and other private sector agents.

Nutritionists and post-harvest specialists are also another type of scientist that is lacking in the national research system. Establishing educational programs to train these experts and then incorporating them into the national research system should be a priority. By linking their work to that of breeders and cropping systems development, small holders are more likely to get feasible and practical alternatives on a timely basis.

The research system and extension systems would benefit from having leaders trained in strategic management. As is true throughout the Mozambican government, due to a lack of trained human resources, those people with higher education quickly move up the ladder. Scientists, not long out of their PhD programs and their dissertation research, as placed in high level administrative positions without the experience and training to guide policy and develop strategies. In addition, they have little time to use the skills and knowledge achieved with advanced training. Rather than external training programs for program development, what might be more valuable is a mentoring system in which experienced professionals from other countries (for example, EMBRAPA directors) come to work with current research and extension administrators, to develop in practice the skills needed to lead an effective government agency.

For setting priorities and strategies, MADER has been able to successfully develop policy analysis capacity with its Department of Policy Analysis, with support through the years from Michigan State University with USAID funding. It provides an example of what long term commitment to human resource development can achieve. However, given the shortage of trained analysts, continued resources for bringing in new people and for advanced education for those currently working will be critical to maintain this base. Political debate on issues of Mozambican farmers and the potential for development of smallholder commercial agriculture is enhanced by the current work, but there are many questions to be informed and debated. This is confirmed by recent debates on the relative importance of large scale commercial agriculture as opposed to smallholder commercial agriculture, where the latter is rejected as an agricultural growth model by some (Boughton and Carrilho, email communication, 11 October 2002).

c. Gaps by major crops of importance to the food insecure

For the food grains, there are various gaps that result in lack of productivity enhancements and nutritional enhancements at the farm level. Regarding QPM, market potential may be limited as long as there are no price differences based on quality standard and this will limit the incentive for adoption of QPM to objectives based on home consumption quality and yields alone. Developing market differentiation for maize, using brand names and advertising campaigns, might establish a new market for QPM or other higher quality maize varieties, such that consumer demand and higher prices would motivate farmers to produce higher quality maize and traders to buy it at a premium. Since domestic millers often buy from neighboring countries due to quality issues, higher quality local maize might compete better in regional markets. How to establish such price differentiation and consumer demand requires coordination with the private sector.

For millet and sorghum, there are easy productivity enhancements through seeds, yet the seed delivery system is weak, especially in the low potential areas. Relying on the private sector for this may not provide the needed boost, and these crops are grown in areas with high food insecurity. Systems for producing adequate quantities and quality of base seed are still lacking, and continued public sector support will be critical for this.

For rice, particularly in Zambezia, germplasm development should be a high priority. FAO has been promising technical expertise in a South-South exchange for about two years and the experts have yet to arrive. Participatory breeding programs of IRRI and WARDA could help provide needed assistance in developing marketable rice. This work involves assessment of processing alternatives, markets, and small-scale irrigation technologies appropriate for farmers with limited resources.

There are many donors and private agents working on the development of cash cropping, but it is not clear that these efforts will identify good alternatives in which participation by the poor can be high. For example, farmers with fewer production constraints, including those with labor and land available for the new crop, can best adopt paprika, with its demanding standards. It is less likely to be adopted by the poor.

When looking at the crops which can most impact poverty reduction in Mozambique, differentiation between high potential and low potential areas leads to specific activities. The interventions needed may require more public sector action needed for poverty alleviation in the low potential areas (Howard et al. 2000). In the south, in addition to the small grains, cashews may play an important role and research support for production and small-scale processing would help. In the north, cassava is a critical crop, with the gaps already mentioned above.

d. Potential interventions that could be linked strategically

One of the lessons learned in the inputs research by Howard, Soares, and Low (2001) is that offering technologies before market demand for the output is developed cannot drive private sector coordination on inputs. If there is no market demand for the crop, there is little farmer demand for the technology, and thus initiatives to get the private sector involved in input distribution will not be successful. For that reason, productivity enhancements that require external inputs will also need to have market development for the output to create that

technology demand. Linking product development with crop production technology and market constraints may have the biggest effect on poverty reduction through agricultural growth.

Cash cropping initiatives with sunflowers and sesame have demonstrated the potential demand for certified seed from smallholders. By enhancing market availability of the seeds as well as marketing of the output, a dynamic for production and income growth is started, one in which the poor can take part when the crops are not excessively demanding. Pigeon pea and cowpeas are such crops, where without major investments, productivity enhancements are possible. The problem is the technology transfer. Will outsourcing through farmer associations, forums, and federations meet the need? If so, are there revenue streams for the associations etc. to bear the costs of this? Need to evaluate the associations and their capacity; calls for more human capital investments so that associations etc. can coordinate and contract these services. If public sector extension is enhanced, could farmer associations provide an operational base and accountability for them, guiding the extension to what they need?

In Zambezia Province, there is great potential in rice production, but both production and marketing aspects need more research. Varietal development could enhance the quality of rice produced, but that would need to be accompanied by processing and marketing development to ensure that the quality efforts received a good price. Brand name development might be one way to attain this, wherein an identity for aromatic local rice was established. Water control systems could be improved, without necessarily full water control irrigation, but technical experts are needed. The delay in the arrival of the FAO experts and possible change to periodic visits as opposed to continued presence over several years, will affect the ability of these experts to evaluate the environment, socio-economic as well as biophysical. The need remains for such work.

Research and extension on storage and processing issues, especially related to cassava and sweet potatoes, would be valuable. In cassava, varietal work to confront diseases means higher quality and more production, yet the market development of cassava is weak and once harvested, households cannot store for very long. Processing methods are not well diffused and there is room for more research and development of small-scale options. Larger scale processing facilities would improve the market outlook for cassava, a crop grown by the poor in almost every region of Mozambique. The orange-fleshed sweet potatoes also have more market potential if processing and consumption options can be more developed. The next few years will be important ones to track the technology diffusion and results. SARRNET and the orange-flesh sweet potato work have excellent potential to improve the food security of the poor.

Along with the development of grades and standards for export, and enhancement of seed availability for groundnuts, particularly the small Spanish peanuts with export potential, INIA or other institution will need to develop local capacity to assess aflatoxin presence, as well as disseminate ways to avoid the problem. This was a clear demand from private sector agents and could be done with collaborators.

Market information system development and diffusion efforts have the potential to link new varieties and crops to market demand, as well as motivate traders and producers to improve their efficiency. Radio programs might include information on sweet potatoes, new cassava varieties, sources of Spanish peanut seed, ways to avoid aflatoxin, home storage to avoid pests, prices for new products, use of prices to evaluate profitability, and a range of educational topics.

The links between research, extension, and education are being strengthened by programs at UEM and Catholic University FAEF. Continued support of these programs will help to overcome some of the human resource constraints over the longer run.

e. Potential leverage on poverty and food insecurity

Clearly research and development of cassava could have a large payoff for Mozambique. Dealing with diseases and pests as well as developing processing and marketability of the crop would increase food security of the poor throughout the country.

Given the large percentage of smallholder households in Zambezia Province producing rice and yet not selling it, developing a solid market for surplus rice production will encourage technology adoption and growth in smallholder incomes in one of the most populous provinces in Mozambique.

Farming systems research in Zambezia would be valuable in those areas where the pigeon pea developments are occurring. Intercropping maize and pigeon peas, as well as other crops, can have excellent results, but there is a need for more work developing systems appropriate to the Mozambican context. A multidisciplinary team is more likely to find options, specifically including women in extension and training. Some of the work will be done by NGOs but the research side is the more difficult one for the NGOs to justify with the donors. Conservation farming has the potential to reduce some of the climatic risks in semi-arid zones, if locally appropriate systems could be designed.

Some of the diet-based nutritional enhancements, such as QPM and orange-fleshed sweet potatoes, have great potential since they do not rely on high capital investments and give households a sustainable way to use their own production to improve nutrition, rather than pills that must be donated or purchased and somehow reach rural areas.

f. Priority areas for human and institutional capacity development

The lack of human resources came up at all levels of discussion. NGOs indicated problems getting trained administrative personnel for offices in the interior and trained agronomists and technicians for field work. A legacy of the years of civil war, educational opportunities are increasing, but universities and training centers are still in the process of developing practical education programs in agriculture. There is need for assistance in these designs, as well as training for agricultural educators. Training in related disciplines, including nutrition and post-harvest storage and processing, is also critical to improving the diets of the poor when production can be increased.

Research system is under-staffed and over-stretched. Clearly funding training for both mid-level and upper-level researchers is critical for research to have sufficient staffing. In several discussions, it has been suggested that “centers of development or research” should be developed that would improve the working conditions for researchers by concentrating resources in a rural station and developing synergies between researchers.

The extension system will continue evolving with a range of alternatives objectives and methods. For MADER to play the coordinating role in a decentralized environment, it needs the evaluation of the range of options as they have been developed in Mozambique to help guide

future development. Having fragmented, piecemeal extension efforts will diminish the efforts for poverty reduction through PROAGRI as indicated in the PARPA.

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Annex A: World Bank Summary of PROAGRI: Attachments 1 and 2 of the Project Appraisal Document on a proposed adaptable programe credit in the amount of SDR 21 million (US$ 30 million equivalent) to the Republic of Mozambique in Support of the first phase of an Agricultural Sector Public Expenditure Program (PROAGRI). Report 18862 MOZ. Washington. World Bank, January 22.

Attachment 1: Table A - Matrix Assessing status of Policies Enabling Development of Agricultural Sector

Areas of Concern	Macro Economy	Trade	Finance	Fiscal	Acess to Land and Natural Resource Management	Protected Areas
Policies already in place	Peace Infaltion down to single digits. Forex rates stable and market determinated. Forex markets open to all entrants.	Tariffs down, rates simplified, and exceptions reduced. Goods and services move freely around country. As of 1998/99 agricultural season, the government will discontinue the use of minimum prices, except for cotton. Government parastatals not receiving subsidies or preferential treatment. Licencing procedures for traders simplified.	Interest rates market determinated. Interest rates down. State banks privatized	Medium ter expenditure framework with sectoral budget ceiling in place. Priorities for sector expenditure defined. PROAGRI - based sector expenditure rationalized. PROAGRI preparation completed.	New Land Law came into effect in 1998, which potentially strengthens tenure security of communities and private investors.	Protected areas registered and gazetted. Pilots in community based resource management, and revenue sharing underway.
Areas Where Policy Change Still Needed to Achieve Sectoral Objectives	Commercial tax code under review. Tax on concessions and land to be defined.	Simplify and dessiminate approval procedure for import and export. Reduce tariff dispersion. Improve product classificacion. Monitoring effects of export taxes on raw cashew and cotton, and variable levy on sugar. Clarify the role of Cereals Institute (ICM). Dessiminate the existing policy and regulations as regard to: a) food security policy and strategy based upon self-reliance rather than self-sufficiency; b) no exports tariffs for food crops. Review of KRII agricultural inputs program required and recommendation to eliminate or reform.	Promote creation of small, micro and rural finance instituition within guidelines designed to ensure financial sustainability. Formulate prudential guidelines for rural financial intermediaries. Real interest rates still high.	Policy on monitoring of donor contribuitions to NGOs and sector budget.	Definition of regulations to Land Law which will provide tenure security for both smallholders and investores, and facilitate transfers. Regulation of tenure establishing procedures for community resource management. Policy on fees for forest explotation (area and volume based). Simplification of titling process.	Policy for devolution of pretected area management to non-government entities. Policy on fees and charges for protected areas (including stumpage fees), and sharing of revenue generated with local communities
Actions Underway towards New Policy		Revision of law regulating private commerce underway				

Table B. Matrix of Pririty Concerns of MAP in Facilitating Market Based Agricultural Development and Natural Resource Managment, and PROAGRI Actions to Address These Concerns

	Macro Environment	Legal Environment	Transpor	Poverty Alleviation	Poverty Rights	Protected Areas	Markets & Data Collection	Research and Extention
Government Agency Responsible	Ministry of Planning & Finance (MPF). Central Bank	Ministry of Justice and Ministry of Industry, Trade and Tourism (MICTUR)	Ministry of Works	MPF, INDER, Ministry of Works, Ministry of Education, Ministry of Helth, MICTUR	MAP and Interministerial Land Commission	MAP and MICTUR	MAP and MICTUR	MAP
MAP Directorate Responsible	Directorate of Economics (DE)	Legal Advisor, DE, DINA, INIA, INIVE	DE, INIA, DPAPs	INIA, DNER, DE, DINA, DPAPs	Legal Advisor, DINAGECA, DPAPs	DNFFB, SPFFB, CEF.	DE,DINA, SIMA, DPAPs	INIA, INIVE, IPA, DNER, CEF, DPAPs
Policy Analyses Needed Under PROAGRI	1. Continously assess effect of macropolicy on sector, and advocote pro-agriculture policies. 2. Join MAP/MPF reviews of the high value of the metical on agriculture.	1. Monitor changes in land, commerce, natural resourse management and others, to ensure they respond to needs of market based agricultural development 2. Disseminate knowledge of legislation to farmers and rural enterprises. 3. Review policy for farmer associations to facilitate their formation, legalization and operation.	1. Establish priorities for feeder road improvment and expansion based on criteria which reflect: a) acess to markets; b) profitability and productive potential and c) poverty alleviation	1. Selection of research/extention activities to reflect priorities of smallholders. 2. Direct transport to improve market access for smallholders 3. Link extention with education and health services for smallholders 4. Define food security priorities.	Adjustment of regulations, and studies to: 1. Ensure equitable access to land and natural resources. 2. Strengthem traditional reghts to natural resources. 3. Improve allocation of land to its most produtive use	1.Complete definition, gazetting and demarcation 2. Adjust policy to provide incentives for sustainable community based resource use, including revenue sharing with communities. 3. Adjust levels and improve collection of exploitation fees.	1. Obtain and analyze price and volume information on national, regional and international markets. 2. Produce crop forecasts. 3. Initiate discussions on links to a commodity exchange	1. Ensure patent and intellectual property legislation to provide incentives for technology transfer and generation. 2. Ensure research and extention responsive to sustainable smallholder farming systems, and focused on highest pay off-off in market economy.
Institutional Actions Needed Under PROAGRI	1. Strenghthen policy analysis capacity in MAP. 2. Rationalize and strengthen capture and analysis of information on agriculture from relevant agencies.	1.Strengthen legal advisor function. 2.Strengthen DE´s policy analyses capacity. 3. Inform subsistence farmers and traders of their rights under existing legislation.	1. Strenghthen DE´s policy analysis capacity 2. Strenghthen DPAP´s policy analysis ability. 3. Formalize links with central and provincial transport planning agencies.	1. Direct research and extention services to needy areas. 2. Carry out food security assessments and formulate response.	1. Delineate community land upon their request. 2. Strengthen cadastral and titling services. 3. Inform smallholders on their reghts to acess to land, and adjudication procedures.	1. Strengthen DNFFB´s monitoring control and revenue collection at provincial level. 2. Strengthen links with police. 3. Develop resource managment capacity at community level.	1. Rationalize and strengthen MAP´s data gathering/analysis in light of policy analysis and planning needs. 3. Rationalize government market information systems. 4. Disseminate price information through the media. 5. Strengthen postharvest analysis & problem solving	1. Strengthen zonal research institutes. 2. Strengthen links to privateresearch. 3. Improve links between research, extension and farmers. 5. Promote/outsource delivery of extention and other agricultural services throught private sector, NGO´s and farmer associations. 6. Train extensionists in useof market information.

Attachment 2: Basic Principles for financing of PROAGRI

Donnors and Government will commit funds to a program of expenditure against commonly agreed *Basic Principles* that define the nature of MAPs transformation. Maps success in implementing the principles will be the basis for annual reviews and budget approval. The principles constitute a contract among donors and Government that will be mutually enforced. The milestones in the middle column will be reviewed annually.

Overarching Principles

Approaches:
- Poverty reduction
- Decentralization and Empowerment
- Good Governance - Transparency, Accountability and Participation.
- Policies, program and activities designed with attention to gender-related issues and implications
- Policies, programs and activities reflect increase attention to environmental and social sustainability
- Market-Oriented Policy Framework
- MAP activities limited to core functions and MAP strengthened to carry them out

Principles	Expected Status Oct.1999	Expected status 2003
Poverty • ultimately, PROAGRI´s success will be measured by its impact on poverty. • PROAGRI´s impact on poverty reduction monitored through appropriate mechanisms/indicators. • Results of impact monitoring reflected in prioritization of program activities.	Indicators and targets established for PROAGRI´s impact on agricultural production and productivity (crops, livestock, forestry), and contribution to rural household income.	Achievement of established targets.
Decentralization & Empowerment • MAP to allocate decision-making and implementation authority among national, provincial & district levels in accordance with subsidiarity principles and functional analysis. • Deconcentrating (and eventual decentralization) of planning and decision making to lower levels in accordance with functional analysis. • Allocation among provinces based on no of rural households, agricultural growth potential, key poverty indicators. • At all levels, broadbased stakeholder participation in program design/monitoring. • PROAGRI budget consolidates recurrent/investment expenditure and reflected in PTIP and MTEF.	Functional analysis completed institutional reforms initiated as necessary to implement results of functional analysis. Provincial 2000 workplans and budgets in accordance with pre-determinated budget ceilings and basic principles. Guideline for prioritization established. Clear progress in involving all relevant stakeholders demonstrated. 2000 budget to be presented as unified expenditure budget.	Institutional reforms called for by functional analysis fully executed. Annual work plans formulated and implemented at district level and provincial level guideline implemented. Mechanisms established and functioning. Status maintained.
Good Governance • Transparency ensured through adoption of internationally acceptable financial and asset management procedures. • Services use most cos-effective delivery mechanism.	Intentionally acceptable financial management system adopted at all levels of MAP. Alternative delivery mechanisms identified and budgeted.	Internationally acceptable financial management system implemented at all levels of MAP. Alternative mechanisms regularly considered
Environmental and Social Sustainability • All PROAGRI activities incorporate principles of environmental and social sustainability • Where negative social and environmental impacts identified, appropriate mitigation measures implemented.	Socioeconomic and environmental assessment capacity established. Work plans include environmental objectives . Pilot EIAs carried out. Potential negative impact and mitigation measures identified.	EIA recommendations implemented routinely. Environmental impact monitored and mitigation measures implemented routinely.

Market-Oriented Policy • Policies and activities encourage competitive private sector initiatives in markets for agricultural inputs and outputs	Clear position on future KRII program	Basic policy reforms in agricultural markets maintained and deepened.
• As appropriate actions taken to establish enabling environment for development of competitive and efficient markets for agricultural inputs and outputs	Existing agricultural market information system (SIMA) has been further institutionalized.	SIMA fully institutionalized.
• Access to and security of land and water rights, especially for smallholders, guaranteed	Regulations adequately securing smallholder land rights being implemented.	
• PROAGRIs contribution to food security objectives pursued through increased quantity and quality of national food production; increased capacity for import, respecting principles of a liberalized market; emphasis on smallholder development	Indicators developed.	Indicators systematically used to monitor food security situation.
Core functions: • Determined on basis of functional analysis which defined levels of authority in decision-making and implementation at all levels	Functional analysis completed and institutional consequences determined.	MAP restructured in accordance with recommendations of functional analysis.
• MAP activities limited to identification of market constraints and advocating measures to overcome them through policy analysis and effective engagement with other sector ministries; providing for equitable access to and security of land and water rights; regulation and standardization of quality control & phyto/zoo sanitary standards for agricultural inputs; ensuring efficient provision of agreed agricultural services; providing enabling environment for private sector development; ensuring efficient natural resource management.		
• MAP's capacity progressively strengthened to carry out core functions	Plan developed as part of institutional reform process.	MAP;s capacity to carry out core functions exists. Status maintained.
• Within scope of PROAGRI, MAP takes lead in coordinating donors and NGOs with regard to their agricultural activities, and as needed, with other Ministries.	Regular donor meetings chaired by MAP, joint Government/donor supervision and reviews, and government ensures all donors adhere to basic principles.	
• Activities implemented by NGOs and financed by donors that are intended to be assumed by MAP to be considered as part of the program for national and provincial planning and budgeting purposes.	Ongoing donor-supported NGO projects catalogues and reviewed, expenditures by component and province estimated	Donor-support to NGOs registered with MAP and MPF and fully reflected in PROAGRI budget and annual work plans.

Institutional Development

Approaches: • Management Support Systems Modernized and Rationalized • Institutional Modernization • Human Resource Development • Sustainable Terms of Employment		
Principles	**Expected Status Oct.1999**	**Expected status 2003**
Management Support • Financial management effective, transparent, accountable • Asset management rational, transparent, accountable • Procurement effective, transparent, accountable • Monitoring and evaluation system used for tracking progress against agreed indicators reflecting program goals. Collected data analyzed and program adapted accordingly. • Modern management information system forms basis for MAP's administration. • MAP's capacity strengthened to collect data for policy analysis; monitor conditions in rural areas and in agricultural sector as a whole; and conduct policy analysis and formulate new policies to respond to emerging problems.	Financial management system established and implemented Asset management system established and implemented Procurement system established and implemented Set of output (result) indicators being used and impact indicators defined Base line dat collected MIS system designed and in place Plan for building policy analysis capacity under implementation	Data on impact of PROAGRI routinely used to adapt policy and strategy MIS fully institutionalized Policy analysis capacity exists in MAP and has contributed to analysis and formulation of policies and programs. Data collection has contributed to policy analysis, and evolved in concert with needs.
Institutional Modernization • MAP structure modernized in line with the functional analysis • Subordinate institutes are autonomous	Functional analysis completed and restructuring plan presented Statue designed to give autonomy to sugar, cotton cashew institutes	Modernization of MAP completed. Autonomy and self financing accomplished
Human Resources • Long term commitment to capacity building at all levels based upon human resource assessment • Agricultural education coordinated between MAP and MINED • Dependence on long-term international technical assistance limited gradually	Human resource assessment done and development plan designed. Coordination mechanisms established and functioning Greater number of TA person-months are contracted on a short-term basis	
Terms of Employment • Terms of employment including incentives compatible with civil service reform • Terms of employment compatible with efficient/effective management of MAP: incentives, remuneration, career advancement, responsibility, mobility, hiring based on merit.	Formal agreement reached with MPF on an incentive scheme and under implementation	

Research

Approaches:

- Priorities focused (but not exclusively) on adaptive and applied research in a farming systems (zoned setting) context; small farmer issues and especially women farmers; sustainable natural resource use.
- Representation of stakeholders (particularly farmers) at National Agricultural Research Council (NARC) and Zonal Research Council (ZRC) level and in research program committees at all levels with priorities and resource allocation decided by stakeholders.
- Linking research, extension, and training through close cooperation between research institutions, extension services, universities, and other relevant training institutions.
- Financing of research through a plurality of sources; Government core funding, cost-sharing, private sector financed contracts, competitive grant facilities
- Provision of research through a plurality of institutions, public and private

Principles	Expected Status Oct.1999	Expected status 2003
• Rationalize use of scarce resources for research	Decision on creation of single agricultural research institute with holistic mandate including social science, subject to feasibility study	Single research institute established under responsibility of a NARC
• Phasing of investments in relation to available human resources and provision of facilitating research conditions	Agricultural research Fund established. Funding based on peer review. Plan for improving researcher employment conditions prepared.	Procedures for multiple funding established and in operation. Employment conditions improved to facilitate quality research.
• NARC responsible for establishing research priorities, national resource allocation, donor coordination	Agricultural Research Council and Research Coordination Unit established in preparation for establishing NARC.	NARC established, in operation and has effectively taken on its tasks.
• Institutions & research organized around agro climatic regions/zones	Two Zonal Research Plans developed.	Min 50% if staff and resources allocated to ZRCs.

Extension

Approaches for publicly financed extension:

- Open to multiple delivery mechanism, including private sector enterprises, associations and NGOs
- Demand-driven, flexible and responsive to diverse and changing needs of farmers
- Market-oriented to help farmers effectively commercialize products and obtain highest return
- Realistic scale, objectives, expected outcomes, with effective monitoring and impact assessment
- Cost-effective so services are delivered at the lowest possible cost to achieve intended objectives

Principles	Expected Status Oct.1999	Expected status 2003
• Integrated research for 'feed-forward" to and feedback from farmers	Mechanisms directly addressing research-extension linkages and formalizing functional interactions among researchers and extension workers in place; funds allocated to linkage mechanisms; on-farm trials and demonstrations provide farmer-extensionist-researcher linkages	Research-extension-farmer linkages through joint farming systems analysis. On-farm research, training, and technology review meetings are bing carried out in a consistent, systematic, and widespread way in all 36 networks.
• Accountable to farmers in program design, implementation, evaluation and funding	Annual work plans and budgets prepared at district level in conjunction with farmers, formal mechanisms and budgets in place linking researchers-extensionists-farmers (joint on-farm work, periodic technology reviews, etc.)	Decentralized extension system in place where farmers are fully engaged in the design, implementation and evaluation of services
• Open to multiple financial and delivery arrangements, including outsourcing, cost-sharing with local extension structures and cost-recovery from farmers/farmer groups	Two or three pilot activities testing alternative delivery and financing mechanisms are bing undertaken with representative and innovative NGOs and the for-profit private sector.	After a review of the cost-effectiveness of the pilot efforts, successful out-sourcing experiments will have been expanded to most provinces.
• Relevant to the different technological and socioeconomic constraints of farmers, especially women and young	Annual work plans have been prepared at the district level in conjunction with farmers; new activities aimed at women farmers and young farmers will have been identified for action in each province	Farming systems teams in place and functioning around Zonal Centers (ZCs) undertaking activities aimed at women and youth; for areas distant from ZCs, clear work plans established including activities aimed at women and youth
• Well-managed and carried out by well-qualified, professional staff at all levels	All new hires with minimum mid-level education; new TORs adopted for extensionists indicating duties and responsibilities and differentiated by employment category (i.e. supervisor, extensionists)	All extensionists of middle or higher level of education; an effective in and out of country training program in place after complete HR assessment; qualified supervisors in place at all levels

Livestock

Approaches:

- Emphasis of livestock program must reflect needs, constraints, opportunities of family farmers by designing interventions (including species and breed) around their specific livelihood systems, production potential and resource capacity
- Development of animal health services delivery must reflect financial viability and affordability. Private sector, community or producer-association managed livestock services, including para-professionals, should provide services where appropriate
- Government support to livestock development should recognize complementary role of private sector, encompass animal production, emphasize small stock, prioritize activities and geographic areas

Principles	Expected Status Oct.1999	Expected status 2003
• Government support to livestock development clearly defined and targeted	Functional analysis of public sector role in livestock development to be presented	Support program in accordance with defined role of public sector under implementation.
• Public spending on livestock development emphasizes small stock, poverty eradication, gender, environmental issues	Analysis of the potential livestock sector contribution to poverty eradication carried out & recommendations developed	Government supported livestock program prioritized according to poverty gender and environmental issues, under implementation.
• Government to create enabling policy and legislation environment for private sector involvement in livestock sector	Legislation analyzed and linked with regional experiences	Appropriate legislation in place. Livestock research managed under single National Research Institute.
• DINAP, INIVE, IPS, and DNER to coordinate livestock programs	Coordination forum established and activated.	Other MAP livestock institutes departments rationalized.

Forestry and Wildlife

Approaches:

- Responsibilities for forestry and wildlife management and distribution of benefits shared among government, communities, private sector, with possible joint ventures involving all stakeholder groups
- Sustainable use of all forest and wildlife resources will be ensured through adaptive management
- Ministerial coordination mechanism for natural resource management in recognized priority area

Principles	Expected Status Oct.1999	Expected status 2003
• Legal framework established for devolution of rights and responsibilities to communities & private sector, encompassing rules for contracts, concessions, agreements, other arrangements	Continuing development of standard contracts. Finalize the process of Gorogosa. Study the possibility of autonomy for FPF.	
• Increased participation of communities in forestry and wildlife management	National conference undertaken to discuss previously prepared methodologies.	Capacity of communities strengthened. A number of joint arrangements for forestry and wildlife utilization effective.
• Sustainable use of forest and wildlife resources ensured through adaptive management	M&E criteria and indicators for forest and wildlife component defined and tested.	Feedback periodically incorporated in management practices.
• Participation of DNFFB in interministerial coordination fora for management of *inter alia* coastal zones/natural resources	Ongoing.	Joint activities being coordinated in the field of *inter alia* coastal zone and natural resource management.

Land

Approaches: The land Component will ensure rights of communities and investors to agrarian land through: improved tenure security, registration systems and adherence to the new Land Law and regulations and the effective implementation; demand-driven selective titling; delimitation of community land rights, and streamlining of land management and registration procedures; decentralization and strengthening of land management functions, and coordination, monitoring and evaluation by the PROAGRI Land Working Group, in collaboration with the Interministerial Land Commission and other sector.

Principles	Expected Status Oct.1999	Expected status 2003
Policy and Legal Framework: Finalize, discuss and approve 1997 Land Law Regulations Support drafting/approval of: • proposed land use planning legislation; • proposed local communities law	Regulations to be approved by Council of Ministers, which *inter alia* facilitate demand-driven selecting titling, community land delimitation, registration, support adjudication, of land access and arbitration of land disputes, including appeals; safeguard secure land access & land use rights for women; facilitate coordination of licensing and concession activities of different ministries; require existing concessions to convert their title in line with 1997 Land Law; requires pipeline concessions to be allocated following provisions of 1997 Land Law & regulations; provide for progressive land tax that would encourage efficient allocation and use of land Task force established and operational in order to ensure processing of land concessions in pipeline. Both new laws drafted and submitted to Assembly.	Necessary policy and regulatory frameworks approved and implemented.
Protecting Land Rights: Ensure rights of communities and investors in agrarian land through: • demand-driven community land delimitation and selective titling • pre-emptive delimitation of community land in high conflict areas	Demand-driven titling and community land delimitation methodologies developed and refined through pilot activities. Draft guidelines and field manuals developed for demand-driven and preemptive delimitation of community lands and completion of pilot activities in three geographic locations. Multi-disciplinary team established in each of the country's three regions to carry out first round of selective titling and undertake in-service training of provincial teams.	Guidelines and manuals revised on the basis of pilot activities Provincial teams trained in use of such guidelines in all provinces. No process of provisional titling/community delimitation takes longer than one year in any province. Established and well-trained multi-disciplinary teams in all provinces.
Community Participation: Involve communities and smallholders in the decision-making process concerning land management and adjudication and conflict resolution through community capacity building and transparent consultation	Provincial inventory of local-level institutions, community-level structures, NGOs which can support local participation in land management and decision-making, conflict resolution. Pilot systems developed through selection of twenty communities (ten in two provinces) that will help develop appropriate procedures and guidelines for local-level land management procedures in areas of high conflict	At least ten communities in each province involved in local-level management and conflict resolution procedures.

Information: Generate and manage information on land use and natural resources within newly strengthened land management institutions at central level and below	GIS established in INIA using existing information and in collaboration with DINAGECA. Land use categories developed and recorded for Cadastral Atlas (scale: 1:50,000) based on existing information in one province	Well-functioning GIS established at INIA to support demand-driven selective titling process in all provinces. Land Use Categories recorded for Cadastral Atlas (scale 1:50,000) based on existing information in all provinces & data produced through demand-driven selective titling procedures.
Capacity Building and Institutional Reform: • Strengthen capacity of INIA, DINAGECA, SPGCs, Interministerial Land Commission & land regulation bodies (eg. Registro predial) • Promote autonomy and administrative/budgetary integration of DINAGECA • Where applicable, decentralize land management functions to district and local level	Staff training and material support for all institutions as specified in Land Component document. Improved experimental budgetary coordination between DINAGECA and SPGCs Draft plan for promoting the autonomy and administrative/budgetary integration of DINAGECA and SPGCs. Rehabilitation and staffing of 2 district level SPGC installations in each province.	Staff training and material support for all institutions as specified in Land Component document. Approved Plan implemented. At least 10 SPGC installations improved and staffed in all provinces.
Effective Monitoring and evaluation and inter-sectoral collaboration: Define mechanisms through which a PROAGRI Land Working Group can monitor and evaluate the PROAGRI Land Component and coordinate with land management institutions, including the Interministerial Land Commission	Land Working Group (LWG) established, meets and produces reports quarterly, establishes M&E indicators, and regularly represented in Interministerial Land Commission (ILC) meetings. Regular intersectorial meetings on overlapping land use activities by different departments and ministries (chaired by ILC).	Significant reduction in land conflicts due to overlapping land use activities by different departments and ministries.

Crop Production

Approaches:
- This component will cover food aid and commercial crops and be limited to agreed findings of functional analysis: establishment/enforcement of legal/regulatory framework for plant production, input supply & seed certification; phytosanitary defense of the country & control of migratory/other pests of widespread geographical effect; collection, processing/dissemination of information on crop situation by the early warming system; establishment of norms and enforcement of standards in seed supply
- Cost recovery for these services will be gradually introduced as applicable
- Services will be contracted out to the private sector when possible

Principles	Expected Status Oct.1999	Expected status 2003
Core functions defined	Core functions identified and timetable prepared for contracting out services	Some core services contracted out
Non-core functions transferred	Majority of non-core functions transferred	All non-core functions phased out
Program component clearly defined/targeted	Component and related work plan and budget in accordance with appraisal recommendations	Core program under efficient implementation.
Cost Recovery	Possibilities for cost-recovery identified	Cost-recovery implemented

Donor Coordination Principles

Approaches: Common Implementation Mechanisms

Principles	Expected Status Oct.1999	Expected status 2003
Common Implementation Mechanisms • Donors undertake with GoM supervision missions, annual reviews. Major purposes of reviews to assess the consistency with basic principles, implementation capacity, performance, available financing and approve AWPB	Evaluation of the 1999 AWPB and assessment of the AWPB for year 200. Assessment of financial management mechanisms and available funding.	Maintained.
• MIS based on common budgeting/financial management procedures adapted by the donors	MIS being implemented. Census and annual impact survey carried out.	Operational.
• Donor funds go into one account in MFP and unified financial management system adopted • Donors accept common reporting and auditing	Core group of donors test agreed procedures. Common reporting formats and audit agreed and implemented.	All donors follow agreed procedures. Maintained.
• MAP manages donor financed vehicles and equipment	New asset management system/transport policy implemented.	Maintained
• Donors adopt common procurement procedures compatible with international standards of procurement	Assessment of common procedures carried out and proposed for common procurement presented.	Operational
• Donors pool resources for procurement of short term TA • Donors support on budget bonus system	Agreement reached and procedures established. Parallel off-budget incentives end. Donors supporting Government's incentives scheme.	Maintained. Maintained.

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